Bilateral lobar lung transplantation and a single lung transplantation using lungs from a single organ donor during coronavirus disease 2019 pandemic

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To the Editor: During the coronavirus disease 2019 (COVID-19) pandemic in China, cadaveric organ donation became drastically reduced, which exacerbated the waitlist morbidity and mortality of lung transplant (LTx) patients. We report a case where we were able to maximize the utilization of the lungs from a single cadaveric donor by performing a single left LTx for one recipient using the donor's left lung, and by bipartitioning the donor's right lung, we were able to perform bilateral lobar transplantation for another recipient.

Recipient 1 was a 67-year-old female with Sjogren syndrome related interstitial fibrosis whose condition was complicated by superimposed bilateral pneumonia. Recipient 2 was a 67-year-old male with pulmonary fibrosis. In February 2020, the conditions of these two patients rapidly deteriorated. The organ donor was a 48-year-old male who developed cerebral hemorrhage during the COVID-19 pandemic. Three consecutive nucleic acid tests on bronchoalveolar lavage and rectal swabs from the donor were negative for COVID-19.

The predicted total lung capacities (pTLC) were as follows: donor, 7.14 L; recipient 1, 4.37 L; recipient 2, 6.74 L. During the COVID 19 pandemic, organ donation activity became drastically reduced, and given the pTLC values shown above, we decided to bipartition the donor's right lung for bilateral lobar transplantation for recipient 1, and to use the donor's left lung for a single left LTx for recipient 2.

The donor's right upper lobe was partitioned from the right middle and lower lobes. The left atrial cuff of the right lung was inspected and three separate openings were observed for the venous drainage corresponding to each of the three lobes. The atrial cuff on the right side was divided as follows: one part contained the right upper lobe pulmonary vein, while the other part contained the right middle and lower lobe pulmonary veins [Figure 1A–C]. The right pulmonary artery was divided distal to the posterior ascending artery. The right bronchial tree was divided at the level of the bronchus intermedius.

Bilateral anterolateral thoracotomy was performed and veno-venous extracorporeal membrane oxygenation (ECMO) was established for recipient 1. After a right pneumonectomy, the donor's right middle/lower lobes were implanted. The recipient's right main bronchus was anastomosed to the donor's bronchus intermedius with continuous 4/0 polydioxanone (PDS). The recipient's right main pulmonary artery was anastomosed to the donor's interlobar pulmonary artery with continuous 5/0 prolene, taking into account the length of the bronchus, to ensure that there was neither undue tension, nor excessive length. The recipient's left atrium was anastomosed to the donor's atrial cuff (containing the veins draining the right middle and lower lobes) using continuous 4/0 prolene.

Next, a left pneumonectomy was performed with preservation of a long length of the recipient left main pulmonary artery and bronchus. A "right-to-left inverted" lobar transplantation using the right upper lobe graft was performed by placing it inside the left chest after rotating 180° along the vertical axis. The recipient left main bronchus and the donor right upper lobe bronchus were trimmed, and anastomosed with 4/0 PDS; the recipient left main pulmonary artery was anastomosed to the donor right upper lobe pulmonary artery with 5/0 prolene; the recipient left superior pulmonary vein was anastomosed directly to the donor right superior pulmonary vein with 4/0

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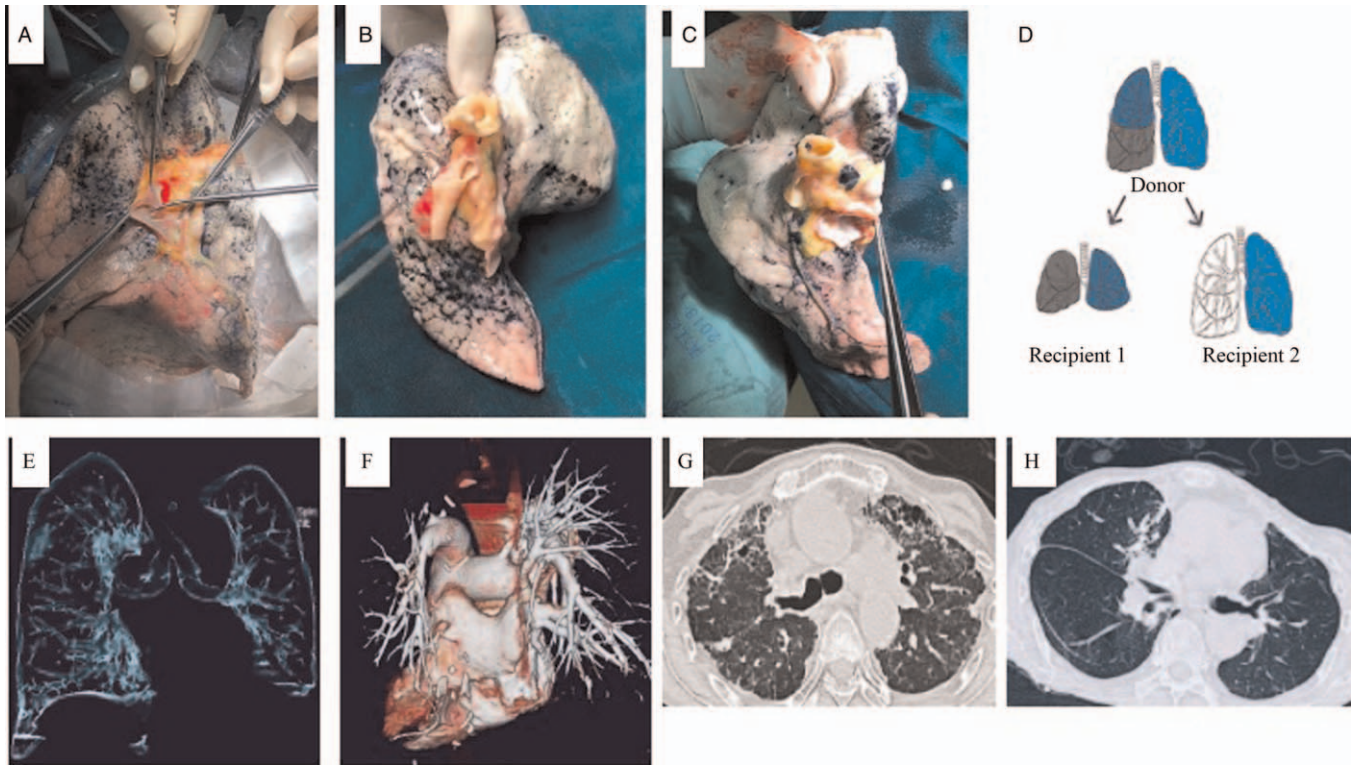

Figure 1: (A) Bipartitioning of the donor right lung—division of the left pulmonary artery. (B) Donor right upper lobe. (C) Donor right middle and lower lobes. (D) Schematic diagram showing splitting of the donor lung. Recipient 1: Donor right lung was bipartitioned for bilateral lobar transplantation. Donor right upper lobe underwent right-to-left inversion for lobar transplantation. Donor right middle/lower lobes were implanted in the right chest. Recipient 2: Single left lung transplantation. (E) 3D reconstruction of bronchial tree after bilateral lobar transplant in recipient 1. (F) 3D reconstruction of vascular structures after bilateral lobar transplant in recipient 1. (G) CT chest of Recipient 1 before bilateral lobar transplantation. (H) CT chest of recipient 1 after bilateral lobar transplantation. CT: Computed tomography.

prolene. After inflation, both grafts appeared to fit well within the recipient chest cavity [Figure 1D]. ECMO was weaned on post-operative day (POD) 2, and the patient was extubated on POD 3. The patient was discharged on POD 33. Post-operative imaging confirmed patent airway and vascular anastomoses [Figure 1E–H].

Follow-up evaluation was made eight months after the operation, and the patient was well with no significant complications. Functional assessments are as follows: forced expiratory volume in 1 s 1.22 L (75% predicted), forced vital capacity 1.32 L (66% predicted), total lung capacity (TLC) 2.43 L (59% predicted), residual volume (RV) 1.28 L (70% predicted), RV/TLC 52.5% (124% predicted). The patient achieved 380 m on her 6-min walk test, with no desaturation. A transthoracic echocardiogram showed an ejection fraction of 63%. There was mild to moderate regurgitation, and a pulmonary artery systolic pressure of 54 mmHg. The bronchial anastomoses appeared satisfactory.

A single left LTx was performed with intra-operative veno-arterial ECMO support for recipient 2, and good size match between the graft and the recipient was observed. ECMO was weaned on POD 3, and the patient was extubated on POD 4. The patient was discharged on POD 29. There were no complications at the 8-month follow-up.

Pulmonary fibrosis patients may deteriorate rapidly, and they constitute the commonest group for cadaveric lobar transplantation.[1] Donor size-matching may be challenging because of the small chest cavities of these patients. Recipient 1 had bilateral pneumonia, and therefore single LTx was not suitable and she required bilateral lung transplantation. Recipient 2, however, was suitable for single LTx. By splitting the donor lungs as described, we maximized the utilization of the available organ at a time of severe donor scarcity, and we were able to perform transplantation for both recipients who were rapidly deteriorating.

During the COVID-19 pandemic, the Chinese national guidelines were followed to reduce the risk of transmission of infection from organ donors.[2] Assessments include severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) nucleic acid test on at least two occasions, influenza A and B antigens, H7N9 nuclei acid testing, next generation sequencing of the lower respiratory tract samples, lower respiratory tract microbiologic culture, and computed tomography of the chest. For suspected SARS-CoV-2 patients, additional tests should be performed for nasal, sputum, lower respiratory tract, blood, and fecal samples.

While graft downsizing by wedge resection is an option, when the donor/recipient pTLC mismatch exceeds 1 L, downsizing by lobectomy is recommended.[1] Couetil *et al*[3] first reported bipartitioning of a cadaveric donor left lung for bilateral lobar LTx. The use of inverted lobar LTx has been described in living lobar LTx, usually

implanting a donor right lower lobe or middle lobe to the left side.[4] Recently, the Okayama group reported a case of lobar LTx with transplantation of a cadaveric right upper lobe to the left side.[5]

The satisfactory early and mid-term post-transplant outcomes of our recipients demonstrate the feasibility of donor lung bipartitioning for lobar transplantation as a strategy to maximize donor lung utilization.

Declaration of patient consent

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

Conflicts of interest

None.

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