

CASE REPORT

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# Left-to-right inverted single-lung transplantation: a case report

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## Abstract

**Background** Lung transplantation is the most effective treatment for end-stage lung disease. However, the shortage of donor lungs is a major limitation. Inverted lung transplantation has the potential to expand the donor pool and make suitable donor lungs available to more patients.

**Case presentation** We present the case of a 65-year-old male who developed interstitial lung disease and pulmonary fibrosis. After a comprehensive evaluation, it was determined that the patient met the criteria for a lung transplantation. The patient's right lung condition was more severe than the left. Based on the allocation system, a suitable left donor lung was assigned to the patient. The patient underwent a left-to-right inverted single-lung transplantation. The transplanted lung gradually regained function postoperatively. Unfortunately, the patient passed away due to multiple organ failure caused by infection two months later.

**Conclusions** In this report, we present a case of left-to-right inverted single-lung transplantation. Based on the pre-operative evaluation and the patient's consent, this surgical approach is feasible. This technique has the potential to broaden the pool of compatible donors and increase the number of recipients.

**Keywords** Lung transplantation, Donor lung, Inverted

## Background

Although transplantation is an effective treatment for end-stage lung disease, the shortage of donor organs remains a dilemma [1]. In China, the China Organ Transplant Response System (COTRS) is used for organ allocation, allowing the most urgent patients to receive donor organs first. However, in some critically ill patients, it is often difficult to match the most suitable ipsilateral donor lung. In these cases, using any available donor lungs for transplantation is important. In patients with end-stage lung disease and bilateral lesions of varying degrees, transplantation can be performed on the side with the most severe lesions. These patients can increase their

chances of rapid transplantation by receiving either side of the donor lung. There have been reports of inverted unilateral lung transplantation internationally, but still few from China [2–4]. Here, we report on a case of a left-to-right inverted single-lung transplantation.

## Case presentation

A 65-year-old male came to the hospital for treatment three years earlier reporting repeated chest tightness and shortness of breath. He was diagnosed with interstitial lung disease and pulmonary fibrosis and subsequently experienced repeated chest tightness and shortness of breath, leading to multiple hospitalizations. One month before preparing for lung transplantation, he was admitted to the hospital due to worsening chest tightness and shortness of breath. A CT(Computed Tomography)scan revealed further exacerbation of pulmonary fibrosis with severe changes in the right lung disease (Fig. 1A). Preoperative ECT (Emission Computed Tomography)

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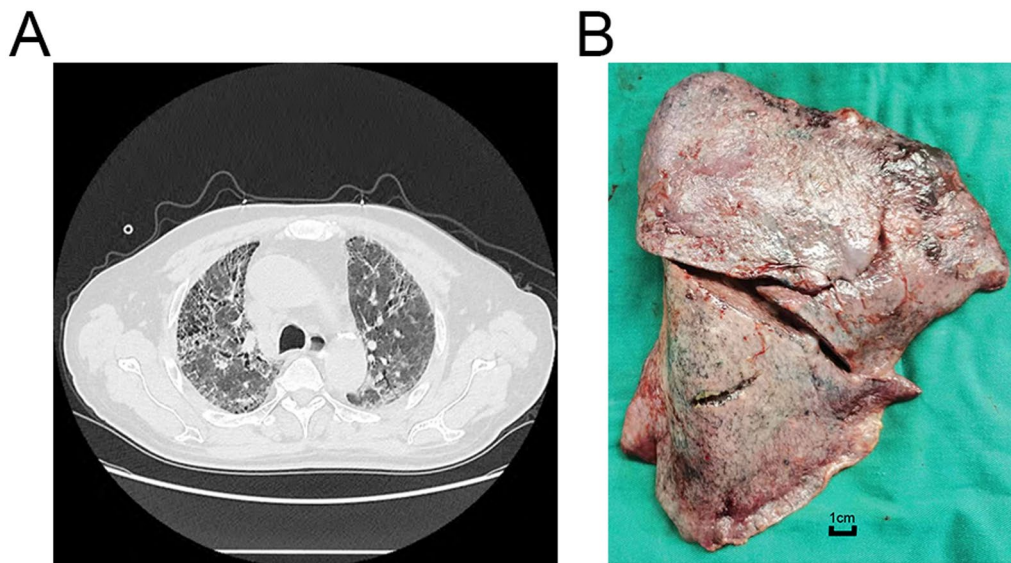
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**Fig. 1** **A** CT scan of the recipient's lungs before lung transplantation. **B** The resected recipient's right lung

revealed diffuse interstitial changes in both lungs, with a left lung FEV1 = 1.09 L \* 71.0% = 0.77 L and a right lung FEV1 = 1.09 L \* 29.0% = 0.32 L. The patient's pulmonary artery systolic pressure, measured by preoperative cardiac ultrasound, was 40 mmHg. After systematic evaluation, this patient indicated indications for lung transplantation and was included in the COTRS system while waiting for suitable donors for lung transplantation. Due to the rapid deterioration of the patient's condition, it was not possible to find a more suitable twin lung donor or a suitable right lung donor, so we decided to perform a left-to-right inverted lung transplant. Under the COTRS system allocation, a suitable left lung donor was found (the donor's right lung was allocated to another recipient).

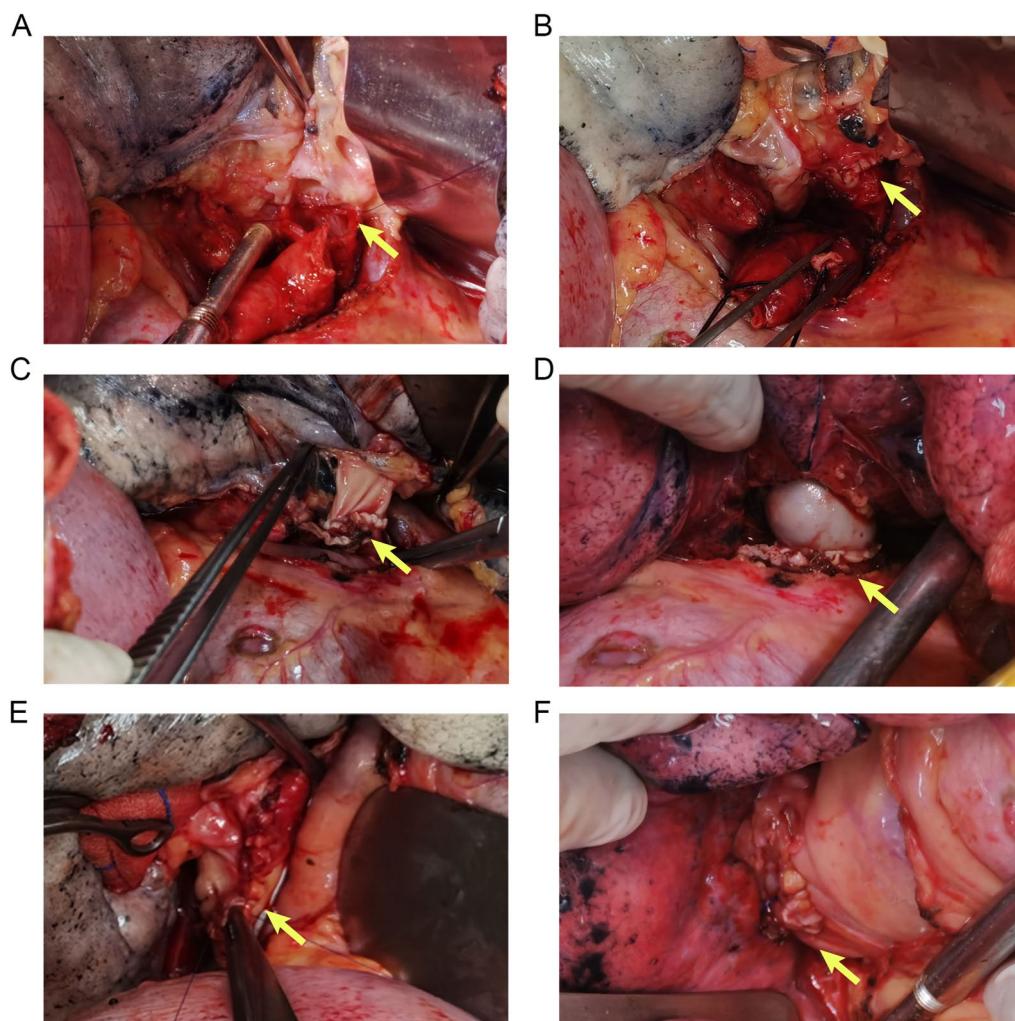
The patient did not undergo ECMO (Extracorporeal membrane oxygenation) before the surgery. We initiated V-A ECMO (femoral artery and vein catheterization) during the surgery after anesthetizing the patient and making a lateral incision in the right chest. The diseased right lung was excised (Fig. 1B), and the donor lung (left lung) was trimmed before undergoing inverted lung transplantation. We first anastomosed the trachea by suturing the posterior wall of the trachea (Fig. 2A) and then sutured the anterior wall of the trachea (Fig. 2B). The pulmonary artery was then anastomosed with a 4–0 Prolene thread for continuous suturing (Fig. 2C). Last, the pulmonary veins were continuously anastomosed using 4–0 Prolene lines (Fig. 2E). The tracheal anastomosis was unobstructed under tracheoscopy, and after all anastomotic stomas were completed, blood flow was opened. The pulmonary artery and pulmonary vein blood

flow were unobstructed (Fig. 2D, F) and the transplanted lung reopened normally. The donor's lung experienced 6 h of ischemia during the surgery. After surgery, the patient was transferred to the ICU for further treatment. The patient's transplanted lung gradually began to function after surgery, and the ECMO was removed one week after surgery. However, two months after surgery, the patient developed secondary multidrug-resistant bacterial infections, ultimately leading to multiple organ failure and death.

### Discussion and conclusions

In this case, we completed inverted left lung transplantation from the donor to the right chest of the recipient. There were no postoperative anastomotic complications, and there was no morphological difference between the inverted left lung graft and the recipient's right chest cavity after transplantation. There was no significant morphological difference between the inverted left lung graft and the recipient's right chest cavity after transplantation.

In inverted lung transplantation, the graft bronchus is located in the middle of the recipient's pulmonary hilum structure, the graft pulmonary artery is located in front of the trachea, and the graft pulmonary vein is located behind the trachea. The stiffness of the bronchi typically determines the positional relationship between the lung hilum structure of the graft and the recipient. Therefore, it is necessary to adjust the sleeve length of the pulmonary artery and vein before anastomosis. When repairing the donor's lung, it is advisable to leave a longer pulmonary artery or fix the pulmonary artery cuff more easily by keeping it as far away from



**Fig. 2** **A** The posterior wall of the bronchus was sutured. **B** The posterior wall of the bronchus was sutured. **C** Completed pulmonary artery anastomosis. **D** The pulmonary artery after restoration of blood flow. **E** Completed pulmonary vein anastomosis. **F** The pulmonary vein after restoration of blood flow

the recipient's main pulmonary artery as possible. For pulmonary vein anastomosis, if the donor pulmonary vein is too short, a pericardium can be used for repair to ensure sufficient length for anastomosis. When repairing the donor's lung, it is advisable to leave a longer pulmonary artery or keep it as far away from the recipient's main pulmonary artery as possible, which can make it easier to fix the pulmonary artery cuff. For pulmonary vein anastomosis, the pericardium can be used for repairing the pulmonary vein to ensure sufficient length for anastomosis if the donor pulmonary vein is too short.

In summary, in specific cases, left-to-right inverted transplantation is feasible, and expanding the matching range of suitable donors and the recipient population.

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Not applicable.

#### Author contributions

Runlei Hu and Jun Chen were responsible for collecting data and drafting the article, Zhoubin Li and Yanni Chen was responsible for manuscript revision, submission and postoperative follow-up, and Weili Han was responsible for the implementation of the surgery as well as the conception of the article. All authors read and approved the final manuscript.

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#### Availability of data and materials

No datasets were generated or analysed during the current study.

## Declarations

### Ethics approval and consent to participate

The studies involving human participants were reviewed and approved by the Ethics Committee of Clinical Research Ethics Committee of The First Affiliated Hospital of Zhejiang University School of Medicine (IIT20240512A).

### Consent for publication

The patient consented to participation in the research.

### Competing interests

The authors declare no competing interests.

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## References

1. Perch M, Hayes D Jr., Cherikh WS, Zuckermann A, Harhay MO, Hsich E, Potena L, Sadavarte A, Lindblad K, Singh TP, Stehlik J, International Society For H, Lung T. The international thoracic Organ Transplant Registry of the International Society for Heart and Lung Transplantation: thirty-ninth adult lung transplantation report-2022; focus on lung transplant recipients with chronic obstructive pulmonary disease. *J Heart Lung Transpl.* 2022;41(10):1335–47.
2. Chida M, Araki O, Karube Y, Maeda S. Right-to-left inverted single lung transplantation. *JTCVS Tech.* 2020;4:395–7.
3. Chida M, Inoue T, Araki O, Maeda S. Left-to-right rotated single lung transplant. *Eur J Cardiothorac Surg.* 2022;62(2):ezac369.
4. Yamamoto H, Miyoshi K, Otani S, Kurosaki T, Sugimoto S, Yamane M, Toyooka S, Kobayashi M, Oto T. Right single lung transplantation using an inverted left donor lung: interposition of pericardial conduit for pulmonary venous anastomosis - a case report. *BMC Pulm Med.* 2020;20(1):46.

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