recently to correct pectus [5]. In our department we have used this approach for mediastinal tumors, and others have performed minor pulmonary resections with excellent results (Table 1). However, this technique has not been previously reported as an option for major pulmonary resections. As described in this paper, a periareolar incision up to 60% of the circumference of the areola can be made without damaging the tissues. This method provides a direct approach to the pulmonary hilum and easy access owing to the elasticity of the skin covering the chest and the motility of the gland. Furthermore, access through the anterior thorax enables wide separation and dissection of the rib arches, whereas in the posterior thorax the ribs are more horizontal, rigid, and closer together. Thus, the mammary approach allows insertion of several instruments without discomfort to the surgeon and with no intercostal neuromuscular compression in comparison with other minimally invasive techniques. In some cases, we used the main periareolar wound to remove the resected lobe, but our experience is only when we performed an intraoperative biopsy of the nodule and then we resected the remaining lobe.

The sensitivity of the nipple and areola is preserved, usually transmitted through the fourth intercostal nerve with lateral extension to the breast, and in our technique, originally designed for men, the skin incision in the lateral quadrant of the areola gives access to the third intercostal space without affecting breast innervation. A reported disadvantage in plastic surgery is the increased risk of infection of breast implants as a result of the number of bacteria that colonize the area, although in our case there was no infection or other complication.

Our experience on this approach is only for male patients up to now. For women we prefer to use a perimammary approach, and we are collecting these cases, too.

The periareolar incision for major lung resection not only offers easy access and satisfactory aesthetic results with respect to classical incisions but is also a technique without difficulty for the surgeon. The wider breadth and greater elasticity of the costal arches in the anterior thoracic region permit insertion of instruments into the chest in a manner that is not uncomfortable or limited, as in other minimally invasive techniques.

References

Contralateral Pulmonary Artery Banding After Single Lobar Lung Transplantation
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A 14-year-old female patient underwent right single living-donor lobar lung transplantation for bronchiolitis obliterans after bone marrow transplantation. The patient experienced a complication with severe hypoxemia requiring venovenous extracorporeal membrane oxygenation, which appeared to result from significant ventilation–perfusion mismatch caused by preferential ventilation of the transplanted lobe and relatively preserved perfusion to the native lung. On day 2, we performed left pulmonary artery banding, which significantly improved oxygenation leading to weaning from extracorporeal membrane oxygenation. Our experience indicates that contralateral pulmonary artery banding may be a feasible option to rescue patients from hypoxemia resulting from ventilation–perfusion mismatch after single living-donor lobar lung transplantation.


Lung transplantation has been established as a lifesaving treatment for adult and pediatric patients with end-stage lung diseases. Bilateral [1] or single [2] living-donor lobar lung transplantation (LDLLT) is an alternative to lung transplantation with cadaveric donors, especially for patients with rapidly deteriorating respiratory dysfunction. The present report illustrates a unique postoperative course of a pediatric patient who showed severe hypoxemia on the basis of ventilation–perfusion mismatch after single LDLLT. The patient required venovenous extracorporeal membrane oxygenation (ECMO) after the operation, and was successfully weaned off ECMO by contralateral pulmonary artery banding (PAB).

A 4-month-old female patient was diagnosed with Diamond-Blackfan anemia. She underwent bone marrow...
transplantation from her mother at 8 years of age, resulting in complete remission of the anemia. However, she began complaining of dyspnea 3 months after the bone marrow transplantation and was clinically diagnosed with bronchiolitis obliterans. Despite immunosuppressive therapy, her respiratory dysfunction gradually progressed, and she was listed for cadaveric lung transplantation at 12 years of age. While on the waiting list, she had pneumonia and her respiratory dysfunction rapidly worsened at 14 years of age. Her mother expressed her willingness for lobar donation, and the patient was referred to us for LDLLT.

The patient was 120 cm in height and weighed 17 kg. She was in bed all day and inspired 6 L/min of oxygen. The chest roentgenograph (Fig 1A) showed a diffuse reticular shadow on both lung fields. The only blood type-matched donor was her mother. She was 161 cm in height and weighed 53 kg. Predicted vital capacities of the recipient and the right lower lobe of the donor were 1011 mL and 913 mL, respectively. The right single LDLLT seemed to provide sufficient pulmonary function, but the graft was estimated to be too large for the hemithorax of the recipient. The surgical option was carefully discussed, and right lower lobe lung transplantation with delayed chest closure [3] was planned. The ethical committee of the Tohoku University Hospital approved this surgical therapy.

The right LDLLT was performed through a clamshell incision to securely institute cardiopulmonary bypass in this pediatric patient with severe respiratory dysfunction. The recipient was placed on a standard cardiopulmonary bypass and the right lung was excised. The right lower lobe of her mother was implanted in the usual manner. After reperfusion and reventilation of the graft, atelectasis of the left native lung and severe hypoxemia became evident. This appeared to result from preferential ventilation of the lobar graft on the basis of a significant decreased pulmonary compliance of the native lung. Inflation of the native lung with jet ventilation markedly improved oxygenation, but the effect was only transient and continued during the procedure. Venovenous ECMO through bilateral femoral veins was instituted, and the chest was temporarily closed.

The second operation was performed on postoperative day 2. A good patency of the pulmonary vascular anastomoses was macroscopically confirmed. Transient cessation of oxygen flow on the ECMO resulted in a decrease in arterial oxygen saturation to 93% under mechanical ventilation with pure oxygen. A significant ventilation-perfusion mismatch with preferential ventilation of the graft and relatively preserved perfusion to the native lung was postulated as the cause of hypoxemia. To wean the patient off ECMO, we decided to reduce blood flow to the native lung by PAB. The left main pulmonary artery was exposed, and significant improvement of arterial oxygen saturation up to 100% was confirmed with transient pulmonary artery occlusion. The PAB was performed using an expanded polytetrafluoroethylene vascular graft (Gore-Tex; W.L. Gore & Associates, Flagstaff, AZ; Fig 2) at the distal side of the main pulmonary artery in preparation for possible left lung transplantation in the future. The diameter of the pulmonary artery was reduced to 5 mm compared with the original diameter of 12 mm. The right ventricular systolic pressure was maintained around 20 mm Hg before and after the left PAB. After PAB, the arterial oxygen partial pressure to inspired fraction of oxygen ratio was 208 mm Hg without oxygen flow to the ECMO, from which the patient was successfully weaned thereafter.

The atelectasis of the left lung, however, was not improved, and the patient was not weaned from the ventilator (Fig 1B). Before considering left pneumonectomy, we decided to try differential lung ventilation. The transplanted lobe and the left native lung were independently ventilated using a double-lumen endotracheal tube with a higher airway pressure on the left side. The dynamic compliance of the right and left side was approximately 7 mL/cm H2O and 3.5 mL/cm H2O, respectively. The independent lung ventilation was continued from postoperative days 14 through 17, which

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**Fig 1.** Chest roentgenographs of 14-year-old girl with bronchiolitis obliterans (A) after bone marrow transplantation before right single living-donor lobar transplantation and (B) after contralateral pulmonary artery banding on day 2 after right single living-donor lobar transplantation. Note atelectasis of the left native lung.
was relatively increased. This appears to have occurred on the basis of severely injured airways and morphologically preserved pulmonary vessels in the native lung, as shown by the pathologic examination of the excised right lung. We performed native lung PAB, and the patient was successfully weaned from ECMO. Pneumonectomy of the native lung was another option in this situation. We proceeded with PAB first because of an anxiety about postpneumonectomy syndrome, which was reported after a single-lung transplantation [4]. Another concern about native lung pneumonectomy was associated with the patient's age. The patient was 14 years old and had the potential to grow. When the patient grows and the transplanted lobe becomes too small for her body, one of the treatment options will be contralateral single-lung transplantation from a cadaveric donor. Native lung pneumonectomy will make retransplantation difficult. In summary, the experience with the present case indicates that PAB may be a feasible procedure to rescue patients from hypoxemia resulting from ventilation–perfusion mismatch after a single LDLLT, which could be considered before contralateral pneumonectomy, especially in pediatric cases.

References


Successful Biventricular Repair of Double-Outlet Right Ventricle With Transposition of the Great Arteries, Pulmonary Stenosis, and Straddling Mitral Valve

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A 9-month-old boy with polysplenia, double-outlet right ventricle (DORV), transposition of the great arteries (TGA), a large ventricular septal defect (VSD), straddling