A case of living-donor segmental lung transplantation and concomitant Nuss procedure in a pediatric patient with pectus excavatum

Satona Tanaka, MD,[a] Sachie Fujioka, MD,[a] Tadashi Ikeda, MD,[b] Takenori Suga, MD,[c] Daisuke Nakajima, MD,[a] Akihiro Ohsumi, MD,[a] Sadashige Uemura, MD,[d] and Hiroshi Date, MD,[a] Kyoto and Nishinomiya, Japan

From the Departments of [a]Thoracic Surgery, [b]Cardiovascular Surgery, and [c]Pediatrics, Kyoto University Hospital, Kyoto, Japan; and [d]Division of Chest Wall Surgery, Nishinomiya Watanabe Cardiovascular Center, Nishinomiya, Hyogo, Japan.

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Address for reprints: Hiroshi Date, MD, Department of Thoracic Surgery, Kyoto University Hospital, Shogoinkawahara-cho 54, Sakyo-ku, Kyoto 606-8507, Japan (E-mail: hdate@kuhp.kyoto-u.ac.jp).

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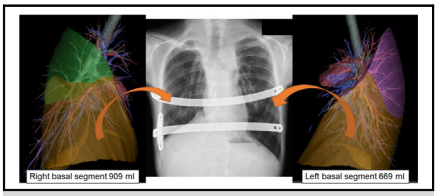


Living-donor basal segmental lung transplantation with concomitant Nuss procedure.

CENTRAL MESSAGE

Living-donor segmental lung transplantation and concomitant Nuss procedure may be effective for lung transplantation for small children with pectus excavatum.

See Discussion on page 203.

Video clip is available online.

To view the AATS Annual Meeting Webcast, see the URL next to the webcast thumbnail.

CLINICAL SUMMARY

A 10-year-old boy with pectus excavatum was referred to our hospital due to the worsening of his respiratory condition. The patient had been waitlisted for deceased-donor lung transplantation 1 year previously due to drug-induced interstitial pneumonia after chemotherapy for neuroblastoma. His oxygen requirement had increased during the waiting period, and intractable pneumothorax had developed. We considered it unlikely that the patient would survive until a deceased donor was allocated; therefore, we planned living-donor lung transplantation. His height had increased during the 1-year period since being waitlisted (from 122 cm to 125 cm) and computed tomography (CT) volumetry revealed that the volume of his chest cavity had become smaller due to the progression of restrictive lung disease (right chest cavity reduced from 517 mL to 410 mL and left chest cavity reduced from 272 mL to 207 mL). Haller index was 8.8 (Figure 1). The donors were his older sisters who were both aged ∼20 years. CT volumetry of donor lung was performed for anatomical size matching. The graft volumes of right and left lower lobes were 1294 mL (S6, 385 mL and basal segment, 909 mL) and 955 mL (S6, 286 mL and basal segment, 669 mL), respectively. We used bilateral basal segments with CT volumetric size matching was estimated to be 255%. Concomitant Nuss procedure was planned to expand the recipient's chest cavity for oversized segmental grafts.

In the donor basal segmentectomy, an intersegmental plane was developed and divided by cautery in situ based on indocyanine green orientation to preserve the S6 segment. The divided intersegmental planes were then covered with fibrin glue and a polyglycolic acid sheet to prevent air leakage. Bilateral basal segmental graft implantation was performed through a clamshell incision under

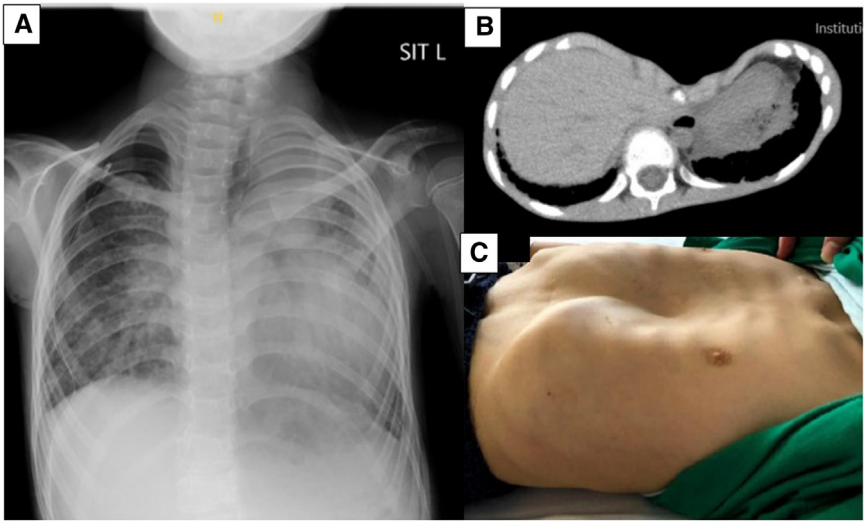
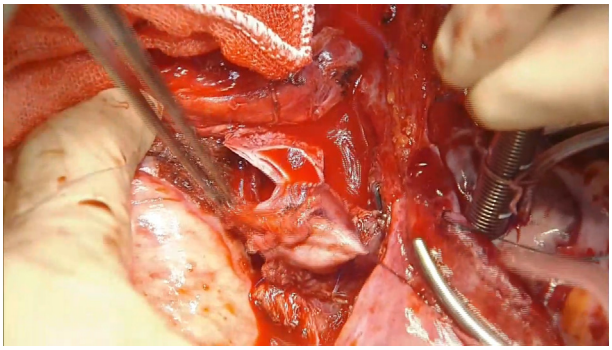


FIGURE 1. Preoperative chest radiograph (A), computed tomography scan (B), and patient's appearance (C) showing right pneumothorax and drug-induced interstitial pneumonia with pectus excavatum (Haller index 8.8).

cardiopulmonary bypass. Donor basal bronchus, pulmonary vein, and the pulmonary artery were anastomosed to recipient main bronchus, main pulmonary artery, and upper part of the pulmonary vein stump of the left atrium, respectively. Right pulmonary venous anastomosis required an autopericardial conduit. The basal segments were vertically rotated 90° after reperfusion. After discontinuation of cardiopulmonary bypass, 2 pectus bars were placed to expand the chest cavity (Video 1). One pectus bar was placed at the cranial side of the sternotomy and fixed with bilateral costal cartilage using nonabsorbable sutures. The other bar was placed at the caudal side of the sternotomy and fixed with chest wall using a stabilizer. Delayed chest closure was required, and the chest was closed on postoperative day (POD) 7. Tracheostomy was performed on POD 10. The patient was weaned off mechanical ventilation on POD 43, and the tracheal tube was removed on POD 62. Complications related to pectus bars were not observed. The patient was discharged home without oxygen therapy 2 months after transplantation. One year after the operation, the patient was doing well. His height was 127 cm. The pectus bar was still in place and the right and left chest cavity volume measured 608 mL and 638 mL, respectively (Figure 2). Postoperative courses of the 2 donors were uneventful and the preserved S6 segments expanded well.



VIDEO 1. Transplantation of bilateral basal segmental graft is performed through clamshell incision. Right pulmonary venous anastomosis requires an auto-pericardial conduit. After reperfusion, 2 pectus bars are placed. Video available at: https://www.jtcvs.org/article/S2666-2507(23)00221-3/fulltext.

DISCUSSION

Chest wall abnormality is considered a contraindication for lung transplantation in most lung transplant centers.[1] Recently, this prevailing view has been challenged by some groups that reported satisfactory outcomes of simultaneous repair of pectus excavatum with lung transplantation.[2-4] A case series from the University of Vienna reported 2 pediatric patients who underwent deceased-donor lung transplantation with concomitant Nuss procedure that was performed with 1 or 2 bars.[4] Complications related to bar placement were not reported. When considering simultaneous correction of pectus excavatum with pediatric living-donor lung transplantation in which large grafts from adult donors are transplanted, Nuss procedure may be preferable to repair without exogenous implants because it enlarges the chest cavity more. However, in the present case, we were concerned that the pectus bar would make the chest wall too rigid, which would interfere with postoperative respiratory recovery and increase the risk of

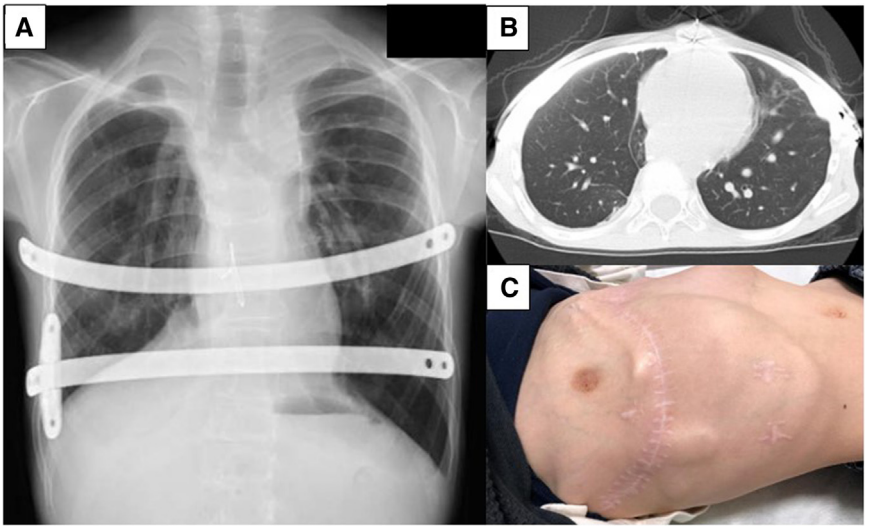


FIGURE 2. Postoperative chest radiograph (A), computed tomography scan (B), and patient's appearance (C) 1 year after surgery.

infection around the bars given the strong immunosuppression that accompanies transplant. Because neither concern was found on a literature search, we proceeded to do the Nuss procedure with living-donor lung transplantation. In this case, 2 pectus bars at the cranial and caudal side of the sternotomy were effective for stable thoracoplasty after clamshell thoracotomy with sternal division.

Regarding the procedure of pediatric living-donor lung transplantation, various procedures were undertaken to deal with the size mismatch between the adult lobar grafts and the child's small chest cavity, including single lobar transplantation and bilateral segmental transplantation. Using 2 different donor grafts might sensitize the recipient and increase the risk of de novo donor-specific anti-human leukocyte antigen antibodies; however, the incidence of de novo donor-specific anti-human leukocyte antigen antibodies is less after living-donor lung transplantation than after deceased-donor lung transplantation. In addition, the contralateral unaffected lung graft may work as a reservoir when acute rejection or chronic lung allograft dysfunction occurs unilaterally (E-References). We recently published a report of our satisfactory short-term outcomes after segmental transplantation in pediatric patients from adult donors.[5] In segmental transplantation, implantation of segmental grafts obtained from different donors is considered preferable if 2 donors are available as in the present case.

CONCLUSIONS

Living-donor segmental lung transplantation and concomitant Nuss procedure is feasible for lung transplantation for small children with pectus excavatum.

Webcast

You can watch a Webcast of this AATS meeting presentation by going to: https://www.aats.org/resources/a-case-of-living-donor-segmental-lung-transplantation-and-concomitant-nuss-procedure-in-a-pediatric-patient-with-pectus-excavatum.

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