

Living-donor segmental lung transplantation for pediatric patients
(小児患者に対する生体肺区域移植)

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研究要旨

末期呼吸不全患者に対する肺移植は有効な治療法であるが、小児患者患者の場合、小児脳死ドナー数は極めて少なく、生体肺移植が重要な救命法である。通常の生体肺移植では、大人の下葉を移植する。しかしながら、著明に胸腔の狭い小児患者には、大人の下葉は大きすぎる。そこで、生体肺区域移植手術を開発した。2009年8月から2021年5月までに6名の小児重症呼吸不全に生体区域切除を行った。原疾患は、造血幹細胞移植後肺障害4例、肺線維症2例であった。下葉+肺底区移植が3例、肺底区+S6区域移植が3例であり、人工心肺下に手術を施行した。1例が手術関連死亡、1例が術後9年目に白質脳症で死亡したが、他の4例は、9か月、10か月、1.3年、1.9年経過した現在生存中である。生体肺区域移植は、著明に胸腔の狭い小児患者の救命法として有効である。

A. 研究目的

著明に胸腔の狭い小児患者には、大人の下葉は大きすぎる。そこで、生体肺区域移植手術を開発し、その安全性と有効性を検討した。

B. 研究方法

2009年8月から2021年5月までに6名（男性4例、女性2例）の小児重症呼吸不全に生体区域切除を行った。年齢は、4-15歳、身長は95-125.2cmであった。原疾患は、造血幹細胞移植後肺障害4例、肺線維症2例であった。下葉+肺底区移植が3例、肺底区+S6区域移植が3例であり、人工心肺下に手術を施行した。

C. 研究結果

合計9区域グラフトが移植されたが、そのうち7区域グラフトは、再灌流直後からよく機能した。反転して移植したS6区域グラフトは2例あったが、いずれもうっ血をきたし、1例は摘出を余儀なくされ、もう1例は、緊急の血管形成が成功した。1例が手術関連死亡、1例が術後9年目に白質脳症で死亡したが、他の4例は、9か月、10か月、1.3年、1.9年経過した現在生存中である。

E. 結論

生体肺区域移植は、技術的には難しいが、著明に胸腔の狭い小児患者の救命法として有効な治療法である。

F. 研究発表

1. 論文

Nakajima D, Tanaka S, Ikeda T, Baba S, Hiramatsu H, Suga T, Ohsumi A, Date H. Living-donor segmental lung transplantation for pediatric patients. J Thorac Cardiovasc Surg. 2022 Aug 6:S0022-5223(22)00828-5. doi: 10.1016/j.jtcvs.2022.07.031. Online ahead of print. PMID: 36088146.

Living-donor segmental lung transplantation for pediatric patients

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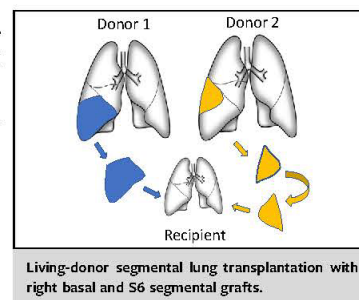
ABSTRACT

Objective: The present study evaluated the outcome of living-donor segmental lung transplantation for pediatric patients.

Methods: Between August 2009 and May 2021, we performed living-donor segmental lung transplantation in 6 critically ill pediatric patients, including 1 patient on a ventilator alone and another patient on a ventilator and extracorporeal membrane oxygenation (ECMO). There were 4 male and 2 female patients, with a median age of 7 years (range, 4-15 years) and a median height of 112.7 cm (range, 95-125.2 cm). The diagnoses included complications of allogeneic hematopoietic stem cell transplantation (n = 4) and pulmonary fibrosis (n = 2). All patients received bilateral lung transplantation under cardiopulmonary bypass. A basal segment and a lower lobe were implanted in 3 patients, and a basal segment and an S6 segment were implanted in the other 3 patients. In 2 patients, the right S6 segmental graft was horizontally rotated 180° and implanted as the left lung.

Results: Among the 9 segmental grafts implanted, 7 functioned well after reperfusion. Two rotated S6 segmental grafts became congestive, with 1 requiring graft extraction and the other venous repair, which was successful. There was 1 hospital death (14 days) due to sepsis and 1 late death (9 years) due to leukoencephalopathy. The remaining 4 patients are currently alive at 9 months, 10 months, 1.3 years, and 1.9 years.

Conclusions: Living-donor segmental lung transplantation was a technically difficult but feasible procedure with acceptable outcomes for small pediatric patients with chest cavities that were too small for adult lower lobe implantation. (*J Thorac Cardiovasc Surg* 2022; ■:1-9)



CENTRAL MESSAGE

Novel living-donor lung transplantation using basal and/or S6 segmental grafts overcame the issue of graft size mismatch for small pediatric patients, showing favorable posttransplant outcomes.

PERSPECTIVE

Various living-donor lobar lung transplant procedures have been employed to deal with graft size mismatch, such as native upper lobe-sparing transplant and/or right-to-left inverted transplant for undersized grafts and single-lobe transplant for oversized grafts. We successfully developed a segmental lung transplant technique for use when an adult lower lobe was too big for a pediatric patient.

See Commentary on page XXX.

The revision of the Japanese organ transplant law allowed families to give their consent to allow organ donation, which has gradually increased the number of organ donations from brain-dead donors.¹ However, the lung transplant candidates who have been newly registered in the Japan Organ Transplantation Network has nearly doubled

in recent years, which has resulted in a severe donor organ shortage. Therefore, the average waiting time for brain-dead donor lungs still exceeds 800 days in Japan, which indicates that many patients on the waiting list die without having the opportunity to undergo lung transplantation.

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