INTRODUCTION

Living-donor lobar lung transplantation (LDLLT) is now an established option to solve donor shortages in lung transplantation (LT). In LDLLT, because the right and left lower lobes from two healthy donors are implanted in the recipient in place of the whole lungs, bronchial stenosis (BS) commonly develops in the lobar to segmental bronchi, which are small both in diameter and length. For the treatment of BS after LT, placement of stents, including self-expandable metallic stents [1], silicon stents and biodegradable stents [2], has become common practice. However, these types of bronchial stents are often too large to fit in the small stenotic bronchi. Although the long-term complication rates of metallic stents are unacceptably high and their usage in many transplantation centres has been nearly abandoned [1], only the balloon-expandable metallic stent (BEMS) [3], which was originally developed as a vascular stent, is currently available for small stenotic airways, such as in paediatric congenital tracheal stenosis [4].

Moreover, it is difficult to maintain the patency of the neighbouring segmental bronchi by stent placement for segmental BS after LDLLT, since the bifurcations of the segmental bronchi of the lower lobe are proximal to the bronchial anastomosis of LDLLT. As a solution to this problem, the kissing-stents technique using BEMSs after LDLLT has been shown to provide favourable outcomes in the case of vascular stenting of the aortoiliac bifurcation and coronary arteries [5]. This technique, involving overlapping of two stents to make a new carina proximally, can guarantee the patency of the target lumen and the side branch. Based on the vascular stenting principle, we applied the kissing-stents technique as a novel procedure for the treatment of multiple segmental BS. Herein, we describe a case of multiple segmental BS treated by the kissing-stents technique using BEMSs after LDLLT.

CASE REPORT

A 17-year old woman with pulmonary arterial hypertension underwent bilateral LDLLT with her father’s right lower lobe and mother’s left lower lobe. The postoperative course was complicated by three episodes of acute rejection and BS requiring six bronchoscopic balloon dilatations in the right transplanted lobe. The forced expiratory volume in 1 s (FEV1) gradually declined from 950 to 390 ml by 3 years after the LDLLT. Although the bronchial stenosis obliterans syndrome was suspected clinically, bronchoscopy showed segmental BS in the right transplanted lobe (Fig. 1A).

After obtaining informed consent, stent placement was performed under general anaesthesia with a rigid bronchoscope at 55 months after the LDLLT.

Firstly, the narrowed segments of the right lobar to segmental bronchi were dilated with a balloon catheter (Fig. 1B). Next, two Express Vascular SD stents (Boston Scientific Co., Boston, MA, USA) were mounted on another deflated balloon catheter (the stent delivery catheter) and positioned side by side within the superior segmental bronchus and the basal segmental bronchus of the right transplanted lobe (Fig. 1C). The stent for the superior segmental bronchus was 6.0 × 15 mm in size, and that for the basal segmental bronchus was 7.0 × 15 mm in size, according to the estimated diameter of the respective bronchi. The exact sites for the stenting were determined by simultaneous use of bronchoscopy and fluoroscopy. Finally, the balloons on both the stent delivery catheters were simultaneously inflated, causing the stents to expand to the size and contour of the respective bronchi in the proper position (Fig. 1D).

After the stent insertion, the patient showed clinical improvement. The FEV1 increased by 720 ml (185%) when compared with the value measured prior to the stenting. No recurrence of the BS...
has been observed until 29 months after the stent insertion. The patient is still surviving at 84 months after the LDLLT.

**DISCUSSION**

To the best of our knowledge, this is the first report of application of the kissing-stents technique using BEMSs for the treatment of multiple segmental BS after LT. The kissing-stents technique involves the deployment of two appropriately sized stents for the main lumen and the side branch, with an overlap of the two stents in the proximal segment of the main lumen, to form a new carina proximally [5]. In addition, the kissing-stents technique necessitates the use of BEMSs. Although BEMSs have rarely been employed in LT [1], BEMSs have been shown to provide favourable outcomes for paediatric congenital tracheal stenosis [4]. Currently, BEMSs exclusively for small bronchial lesions are available. Their usefulness in cases of small airway stenosis also led us to consider the use of BEMSs for dealing with segmental BS after LDLLT.

The most frequent complication after metallic stenting is restenosis due to the formation of granulation tissue [1, 3]. To reduce the risk of restenosis, we repeated balloon dilatation during the first several postoperative months before the stent insertion. No potential complications, including migration, bleeding or infection, were encountered. We did not attempt stent removal, because removal of an epithelialized BEMS would be difficult and potentially hazardous to the patient.

This technique should be indicated in BS without mucosal necrosis, and in the distal bronchial tree where silicone stents cannot be placed and where no surgical procedure can be performed. Additionally, this technique would not preclude a retransplant procedure when necessary.

Given the fact that the number of cadaveric lobar LTs has recently increased to solve the problem of donor shortages in LT, the number of cases developing segmental BS after lobar LT could also increase in the future. The kissing-stents technique using BEMSs may serve as a valuable therapeutic option in selected cases with segmental BS after lobar LT.

**Conflict of interest:** none declared.

**REFERENCES**


