Transposition of the lower pulmonary vein for further mobilization in carinal reconstruction after induction therapy for lung cancer

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In carinal reconstruction, which can conserve healthy lung parenchyma, the airway anastomosis must be performed absolutely free of tension. Herein, we report a case in whom the conserved right bronchus intermedius was successfully implanted to the side of trachea after performing a double-sleeve upper lobectomy with carinal resection by transposing the lower pulmonary vein to the opening of the upper lobe vein. This technique may be adequate and indicated when further mobilization is needed for carinal reconstruction in poor-risk patients, such as those who have undergone induction therapy.

Clinical Summary

A 50-year-old woman with a severe cough was admitted with complete atelectasis of the right lung. The emergency fiberoptic bronchoscopy showed that the right main bronchus was obstructed by a tumor of an adenocarcinoma. A computed tomographic (CT) scan showed a 5-cm mass adjacent to the right pulmonary artery (Figure 1). After 2 cycles of cis-diaminedichloroplatinum- and docetaxel-based chemotherapy with concurrent irradiation of 40 Gy, the bronchial obstruction was relieved and a chest CT scan demonstrated a major response (Figure 2). She was indicated for surgery as T4 N1 M0.

Operation

A fifth intercostal thoracotomy was performed, revealing a tumor involving the right wall of the carina and the right main bronchus up to the upper lobe bronchus. After dividing the azygos vein, the paratracheal and subcarinal lymph nodes were dissected. As the middle lobe was almost completely free of lobulations in relation to the upper lobe, its arteries, bronchus, and then the superior pulmonary vein were divided with staplers. The tumor also involved the posterior wall of the interlobar pulmonary artery just distal to the upper lobe branch. After systemic heparinization, a

Figure 1. Preinduction CT scan shows a large mass originating in the right upper lobe invading the carina and the right main bronchus.

Figure 2. After concurrent chemoradiotherapy, CT scan demonstrated a major response. We restaged as T4 N1 M0.

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complete segmental resection was performed and the interlobar artery was reanastomosed (Figure 3).

Being fully mobilized from its mediastinal bed, the lower trachea and the carina plus the left main bronchus were resected.

Figure 3. The pulmonary vein of the right lower lobe was cut from the atrium (*asterisks*) and anastomosed to the stump of the upper pulmonary vein of the atrium (*PV*). The pulmonary artery was reconstructed by an end-to-end anastomosis (*PA*).

The upper-middle lobectomy was completed by transecting the bronchus intermedius below the takeoff of the upper bronchus. The anastomosis of the trachea and the left main bronchus was accomplished as a “telescope anastomosis”¹ with a single interrupted whole-layer suture with 3-0 polydioxanone II (Ethicon, Inc, Somerville, NJ).

Because the diameter of the right bronchus intermedius was almost the same as the left main bronchus, the opening on the lateral wall of the left main stem would have been too large for an end-to-side anastomosis. In spite of intrapericardial mobilization of the right hilum, however, the opening of the bronchus intermedius could not be brought up to the trachea above the anastomosis. The lower vein was then resected with a sufficient venous cuff and transferred to the site of the upper vein with a continuous suture (Figure 3). The lower bronchus was then elevated and implanted in the lateral wall of the trachea 2 cartilage rings above the first anastomosis using interrupted sutures with 4-0 polydioxanone II. A pedicled pericardial fat pad was interposed between the airway and arterial anastomosis (Figure 4). After the operation, mild anticoagulation therapy was administered for a month.

The tumor was a well-differentiated adenocarcinoma involving the tracheobronchial lymph node with a large degree of fibrous changes. No metastasis was detected in any other lymph nodes. Bronchoscopic examination a month after operation revealed white and necrotic mucosa along the cartilage of the lower bronchus just distal to the end-to-side anastomosis. This stricture was successfully treated by placing an expandable metallic stent following balloon dilation. She is now well and without relapse 6 months after operation.

Discussion

When tumors involve the carina and main bronchus to the lobar orifice, a variety of techniques for reconstruction are used.² The remaining lower lobe can be mainly anastomosed end-to-side to either the trachea or the left main bronchus across the mediastinum. Anastomosis on the left main bronchus is not desirable when

Figure 4. The bronchus intermedius is anastomosed to the side wall of trachea after mobilization by transposition of the lower pulmonary vein. *PA*, *PV*, and *asterisks* indicate the same as in Figure 3.

the opening becomes relatively large compared with its wall. This additional anastomosis can also increase tension on the tracheobronchial anastomosis. Bringing the lower bronchus up to the level of the trachea, on the other hand, can lead to airway complications.³ Toomes and colleagues⁴ first described lobe transposition in which the lower lobe vein is transferred to the site of the upper vein for further mobilization in a double-sleeve resection. In our case, including the carinal resection resulted in a more extensive defect that had to be bridged, and this mobilization made it possible to elevate the bronchus intermedius more than 1 cm higher after complete circular pericardiotomy and to release tension on the anastomosis.

Postoperative airway narrowing distal to the end-to-side anastomosis in this case appears to be caused by ischemia during vascular anastomosis. Careful attention must be given to devascularization of the retained lung; quick anastomosis of the pulmonary artery and vein is needed. Moreover, we would rather take a step of pulmonary preservation technique: cooling of the mobilized lobe or infusion of a lung preservation solution into the pulmonary artery.

Herein, we have described transposition of the lower lobe vein for mobilization in a double-sleeve lobectomy with a carinal resection after induction chemoradiotherapy for locally advanced lung cancer. This should allow safer reconstruction of the carina under poor conditions such as induction therapy.

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