

# Left secondary carinal resection and reconstruction for low-grade bronchial malignancies



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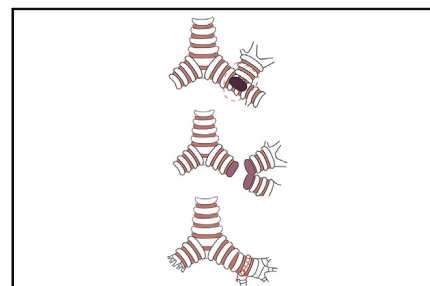
## ABSTRACT

**Objectives:** A rare and complex procedure, total lung sparing left secondary carinal resection and reconstruction is only performed in a few specialized centers in a restricted group of patients. We reviewed our experience to evaluate its safety.

**Methods:** Patients who underwent left secondary carinal resection and reconstruction with complete lung parenchymal preservation for low-grade bronchial malignancies at the Shanghai Chest Hospital and the Padua University Hospital were retrospectively reviewed. Clinicopathologic factors and perioperative outcomes were analyzed.

**Results:** Thirty patients underwent the procedure between July 2012 and July 2019 (mean age, 42.9 years). No operative mortality occurred and postoperative complications developed in 4 patients (13.3%), including pneumonia (n = 3 [10.0%]), subcutaneous emphysema (n = 2 [6.7%]), and prolonged air leak (n = 2 [6.7%]). Pathologies included adenoid cystic carcinoma (n = 11), mucoepidermoid carcinoma (n = 6), carcinoid tumors (n = 9 [8 typical and 1 atypical subtypes]), inflammatory myofibroblastic tumor (n = 3), and myoepithelioma (n = 1). The margins were positive in 8 patients (26.7%), whereas 2 patients (6.7%) had positive lymph nodes. Adjuvant therapies were performed postoperatively, including chemoradiotherapy for positive lymph nodes and radiotherapy for positive margins.

**Conclusions:** Total lung sparing left secondary carinal resection and reconstruction can be performed safely in well-selected and oncologically appropriate patients with low-grade bronchial malignancies. (JTCVS Techniques 2021;8:196-201)



A new secondary carina is reconstructed by anastomoses between the main and lobar bronchi.

## CENTRAL MESSAGE

Left secondary carinal resection and reconstruction with total pulmonary parenchymal preservation is feasible for selected patients with low-grade bronchial malignancies.

## PERSPECTIVE

A rare and complex procedure, total lung sparing left secondary carinal resection and reconstruction for highly selected and oncologically appropriate patients with low-grade bronchial malignancies is feasible, with acceptable morbidity and mortality when performed in experienced centers.

See Commentaries on pages 202 and 203.

▶ Video clip is available online.

Since the first description in 1947,<sup>1</sup> bronchoplastic procedures have become increasingly accepted as the surgical treatment for different tumors. As for low-grade malignancies involving the main bronchi, such as adenoid cystic

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### Abbreviations and Acronyms

CT = computed tomography

carcinoma, mucoepidermoid carcinoma, and carcinoid tumors, which have a reported 5-year overall survival ranging from 52% to 100% and a 10-year survival from 29% to 90%,<sup>2-8</sup> bronchoplastic procedures with pulmonary parenchymal preservation may maintain a patient's quality of life without compromising the oncologic result of the surgery, especially for patients with poor pulmonary function.<sup>5,9</sup> Even for patients who undergo R1 resection for low-grade bronchial malignancies, postoperative adjuvant radiotherapy helps improve the prognosis.<sup>10</sup>

Parenchymal sparing resection of the left secondary carina for low-grade malignancies is a complex procedure, performed in carefully selected patients in specialized centers.<sup>9,11-13</sup> There are only a few case reports or case series on this procedure in limited sample sizes because the low-grade bronchial malignancies suitable for this technically demanding procedure are relatively rare. Here we evaluate the perioperative outcomes of left secondary carinal resection and reconstruction performed in 2 centers.

## MATERIALS AND METHODS

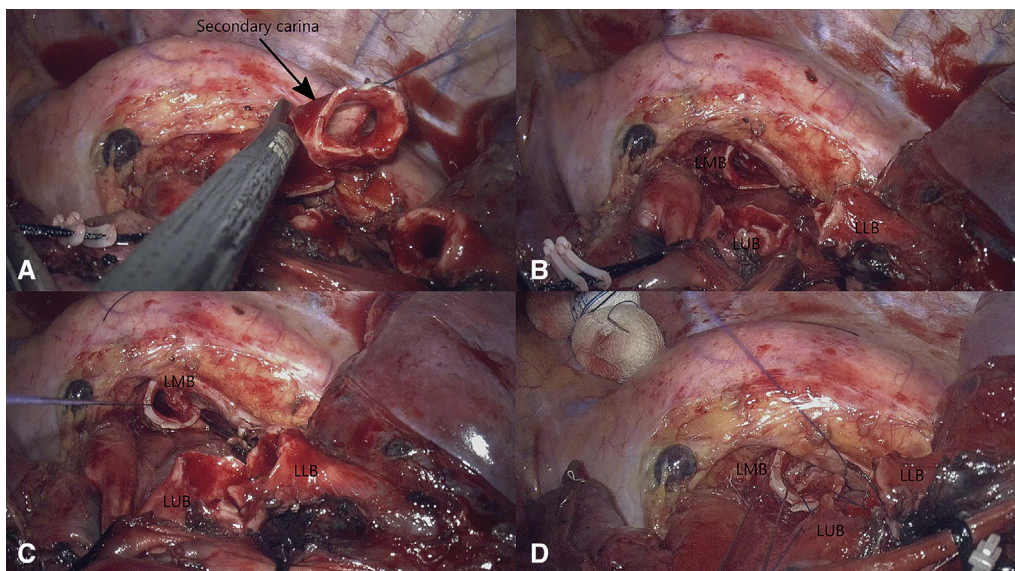
### Patients

From July 2012 to July 2019, patients who underwent left secondary carinal resection and reconstruction with pulmonary parenchymal preservation for low-grade malignant bronchial tumors at the Shanghai Chest

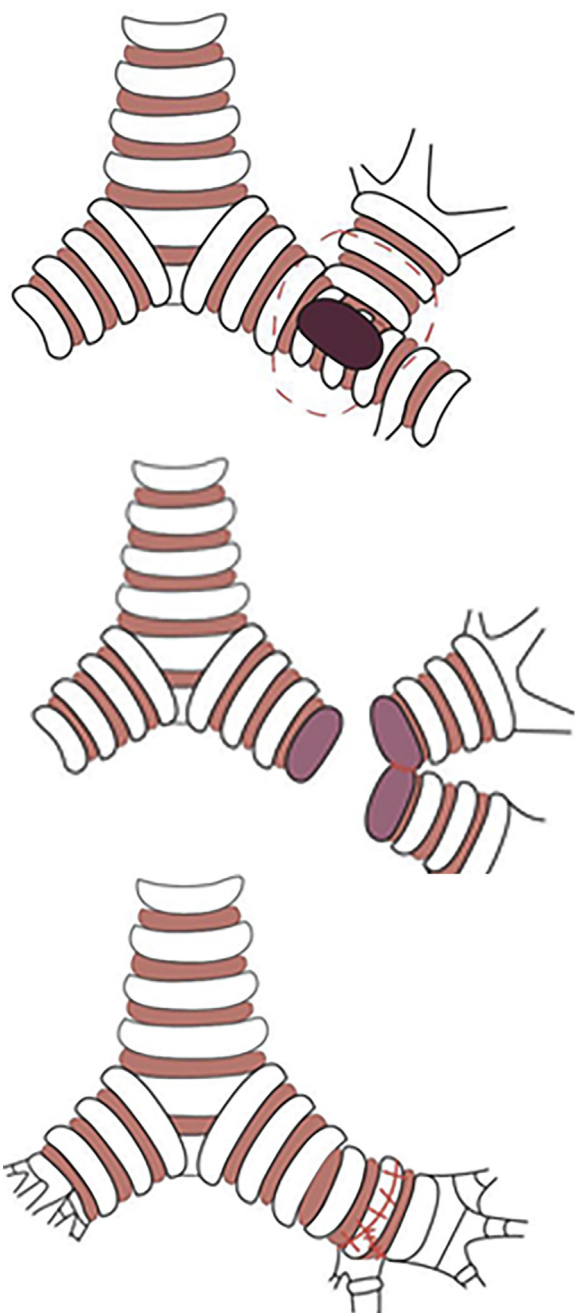
Hospital and the Padua University Hospital were retrospectively reviewed. The institutional review board of these hospitals approved the retrospective study (ethics approval KS1992 for the Shanghai Chest Hospital and chpd2020-11-583 for the Padua University Hospital). Written informed consent was obtained from the patients for the publication of the data. The indications for this procedure were the low-grade malignant tumors originating from the distal left main bronchus, close to or involving the orifices of the upper and lower lobar bronchi confirmed by bronchoscopy and biopsy, including adenoid cystic carcinoma, mucoepidermoid carcinoma, carcinoid, myoepithelioma, and inflammatory myofibroblastic tumor. Meticulous assessment was accomplished by both expert thoracic surgeons and anesthesiologists before the surgery, including a detailed interview, physical examination, computed tomography (CT) scan of thorax, brain magnetic resonance imaging, positron emission tomography/CT, cardiopulmonary function evaluation, and bronchoscopy examination. The clinicopathologic factors and perioperative outcomes were analyzed in this study.

### Surgical Technique

Dedicated thoracic anesthesiologists managed the anesthesia during the operation. After intubation with a right-sided double-lumen endotracheal tube under the bronchoscopic vision for single-lung ventilation, the patients were placed in the right lateral decubitus position and operated from the left side. The interlobar fissure was divided at first and then lymph nodes station 4L, 5, 6, 7, 8, 9, and 10 were routinely dissected for accurate staging and better exposure. The inferior pulmonary ligament was also divided to reduce the anastomotic tension. After isolating the distal end of the left main bronchus and the origins of the 2 lobar bronchi, the left secondary carina was transected with macroscopically negative margins (Figure 1, A and B). The frozen section analysis was conducted to confirm microscopically negative margins. Additional resections were necessary if the resected margins were positive while maintaining permissive anastomotic tension, and negative margins were considered to be achieved without pneumonectomy or carinal pneumonectomy. The reconstruction of the left secondary carina was performed by the side-to-side anastomosis between the upper and lower lobar bronchi with interrupted



**FIGURE 1.** A and B, The left secondary carina was resected after the exposure of the distal end of the left main bronchus (LMB) and the origins of the 2 lobar bronchi. C, The side-to-side anastomosis was performed between the upper and lower lobar bronchi with the interrupted Vicryl sutures. D, The LMB was anastomosed with the newly reconstructed secondary carina using a continuous Prolene 3-0 suture. LUB, Left upper lobe bronchus; LLB, left lower lobe bronchus.



**FIGURE 2.** The whole surgical procedure of left secondary carinal resection and reconstruction.

Vicryl sutures tied outside the lumen of the bronchus (Figure 1, C) and then the anastomosis between the left main bronchus and the newly reconstructed secondary carina using a continuous Prolene 3-0 suture (Figure 1, D). The whole surgical procedure is depicted in Figure 2 and Video 1. Finally, the anastomosis site was carefully checked for air leaks with an airway pressure of 30 cm water and inspected by bronchoscopy.

### Postoperative Management

After the surgery, the patients were encouraged to cough and become ambulatory, and respiratory function training was carried out. Inhalation



**VIDEO 1.** Left secondary carinal resection and reconstruction. Video available at: [https://www.jtcvs.org/article/S2666-2507\(21\)00379-5/fulltext](https://www.jtcvs.org/article/S2666-2507(21)00379-5/fulltext).

of low-flow oxygen, prophylactic use of antibiotics, aerosol, and expectorant was applied. Bronchoscopy might be performed to remove excessive secretions or check the anastomosis. The chest tube was removed when the chest radiograph examination showed good lung expansion, no obvious air leaks, and drainage volume <100 mL. In general, the adjuvant therapy, including chemotherapy and radiotherapy, was administered for patients with positive resected margins or lymph nodes about 4 to 6 weeks after the surgery (Figure 3).

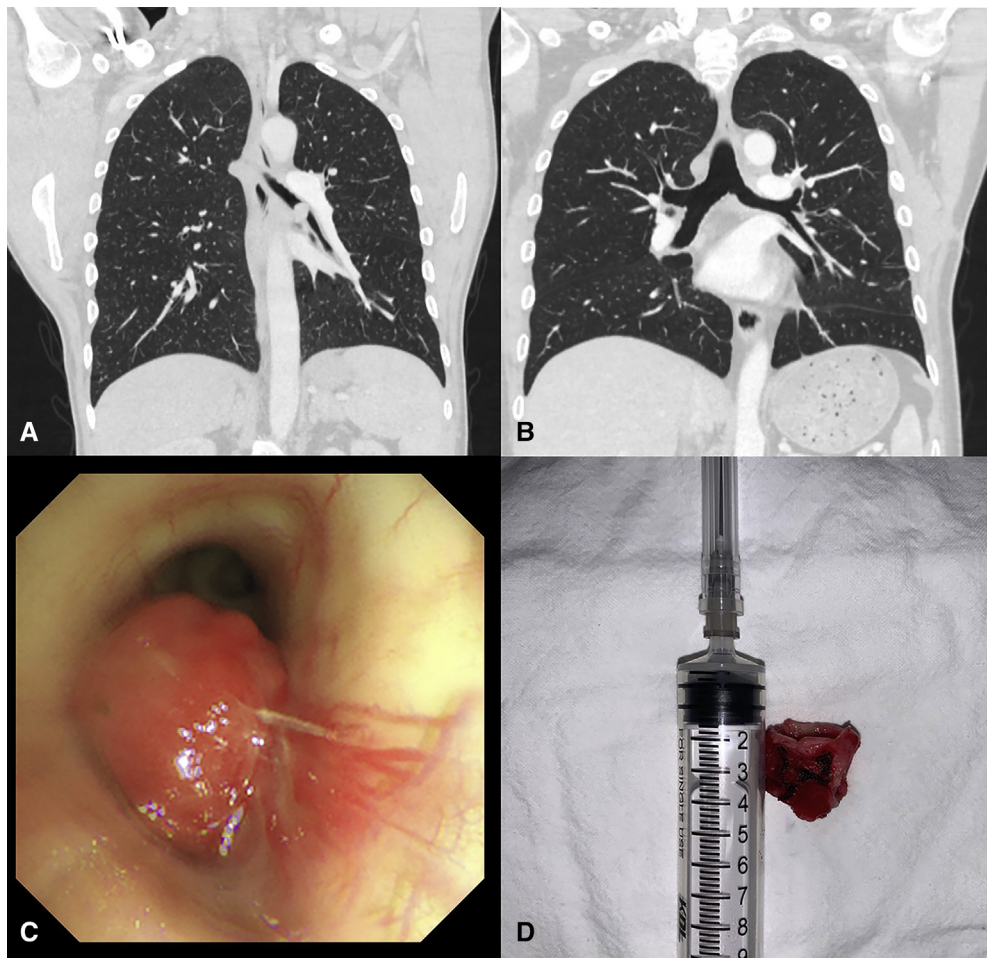
### Statistical Analysis

The categorical variables were expressed as number and percent, whereas the continuous variables were expressed as mean  $\pm$  standard deviation in a normal distribution, or median with the range in a nonnormal distribution. Intergroup differences were compared by the Student *t* test or the Mann-Whitney *U* test. The statistical analysis was performed using SPSS version 26.0 software (IBM-SPSS, Inc, Armonk, NY).

### RESULTS

Altogether 30 patients (20 men and 10 women) were enrolled in this study, 26 patients from the Shanghai Chest Hospital and 4 patients from the Padua University Hospital. The mean age was 42.9 years in this cohort, ranging from 16 to 67 years (Table 1). Four patients had comorbidities before admission, including hypertension ( $n = 2$  [6.7%]), diabetes mellitus ( $n = 1$  [3.3%]), and chronic obstructive pulmonary disease ( $n = 1$  [3.3%]). Five patients (16.7%) were former smokers. Obstructive pneumonia or atelectasis were observed in the preoperative CT images of 9 patients (30.0%) due to the intraluminal tumors. Three patients (10.0%) received treatment before the surgery, including chemotherapy ( $n = 1$ ) and endoscopic snare excision ( $n = 2$ ).

The surgical characteristics are shown in Table 2. The majority of cases ( $n = 29$  [96.7%]) were performed through left posterolateral thoracotomy, whereas 1 patient (3.3%) received robot-assisted thoracoscopic surgery. The mean operative time was 127.8 minutes, and the average intraoperative blood loss was 120.0 mL. At the final histologic examination, the tumors were found to be adenoid cystic carcinoma ( $n = 11$  [36.7%]), mucoepidermoid carcinoma ( $n = 6$  [20.0%]), typical carcinoid ( $n = 8$  [26.7%]),



**FIGURE 3.** A and B, The preoperative and postoperative computed tomography images of patients receiving left secondary carinal resection and reconstruction. C, The manifestation of the preoperative bronchoscopy examination. D, The resected left secondary carina.

atypical carcinoid ( $n = 1$  [3.3%]), inflammatory myofibroblastic tumor ( $n = 3$  [10.0%]), and myoepithelioma ( $n = 1$  [3.3%]). The resected margins were confirmed negative in 22 patients (73.3%), whereas positive in the remaining 8 patients (1 patient with typical carcinoid and 7 patients with adenoid cystic carcinoma), including 3 cases of isolated positive proximal margins and 5 cases of simultaneously positive proximal and positive distal margins. None of them had purely positive distal margins. The mean length of bronchus resected was 2.1 cm. No significant difference was detected when the length of the resected bronchus was further compared between patients with negative and positive margins by the Mann-Whitney  $U$  test ( $2.1 \pm 0.8$  cm vs  $2.3 \pm 1.2$  cm;  $P = .696$ ). Two patients (6.7%) had positive lymph nodes, 1 of them with adenoid cystic carcinoma (1 lymph node in the aortopulmonary window station, station 5) and the other patient with mucoepithelioid carcinoma (1 lymph node in the lower paratracheal station, station 4L).

No operative mortality occurred and postoperative complications developed in 4 patients (13.3%). Three of them

had pneumonia treated with antibiotics and physiotherapy. Two patients experienced subcutaneous emphysema and prolonged air leak (lasting more than 5 days). No obvious anastomotic defects were detected by bronchoscopy, and these patients were also treated with antibiotics and physiotherapy without any additional intervention. The median duration of chest tube drainage was 5 days (range, 3-9 days), and the median length of hospital stay was 7 days (range, 4-15 days). After the surgery, 9 patients received adjuvant therapy, including chemoradiotherapy for the 2 patients with positive lymph nodes, and radiotherapy for the remaining 7 patients with positive resected margins (Table 3).

## DISCUSSION

Bronchoplastic procedures have been widely adopted in the surgical treatment of different degrees of malignancies involving the bronchus that spare the pulmonary parenchyma without impairing the oncological prognosis compared with standard lung resections.<sup>14,15</sup> Pure bronchial sleeve resection with complete pulmonary parenchyma

**TABLE 1. Demographic characteristics of patients receiving left secondary carinal resection and reconstruction**

Variable	Overall (N = 30)
Sex	
Male	20 (66.7)
Female	10 (33.3)
Age (y)	42.9 ± 13.3
BMI	24.8 ± 2.5
Smoking history	
Never smoker	25 (83.3)
Former smoker	5 (16.7)
Comorbidities	
Hypertension	2 (6.7)
Diabetes mellitus	1 (3.3)
COPD	1 (3.3)
FEV1%	79.5 ± 21.8
DLCO%	89.8 ± 19.5
Preoperative obstructive inflammation/ atelectasis/consolidation	
Yes	9 (30.0)
No	21 (70.0)
Preoperative treatment	3 (10.0)
Chemotherapy	1 (3.3)
Endoscopic treatment	2 (6.7)

Values are presented as n (%) or mean ± standard deviation. *BMI*, Body mass index; *COPD*, chronic obstructive pulmonary disease; *FEV1*, forced expiratory volume in 1 second; *DLCO*, diffusing capacity of lung for carbon monoxide.

preservation is also feasible in the surgical treatment of benign lesions or low-grade malignant tumors, such as stenosis, disruptions after traumas, adenoid cystic carcinoma, mucoepidermoid carcinoma, and carcinoid tumors.<sup>9,11,12,16-18</sup> For lesions located in the distal main bronchus close to the origins of lobar bronchi, secondary carinal resection and reconstruction has been described by several case reports. It is technically demanding, especially on the left side because the aortic arch and descending aorta are in proximity to the hilum and the left pulmonary artery is just above the left main bronchus.<sup>19</sup> However, due to the complexity and rarity of left secondary carinal resection and reconstruction for low-grade malignancies, its safety has not been well evaluated yet.<sup>11,17,18</sup>

In this study, the perioperative outcomes were investigated in patients who received left secondary carinal resection and reconstruction for low-grade malignancies. Among them, only 4 patients experienced postoperative complications treated successfully with antibiotics and physiotherapy, including subcutaneous emphysema, prolonged air leak, and pneumonia. No operative mortality occurred. As reported in the literature, sleeve resections are more often associated with specific complications than standard lung resections, such as persistent atelectasis, stenosis, dehiscence of the anastomosis, and empyema.<sup>20-23</sup> No

**TABLE 2. Surgical characteristics and histological examination of patients receiving left secondary carinal resection and reconstruction**

Variable	Overall (N = 30)
Approach	
Minimally invasive surgery	1 (3.3)
Open surgery	29 (96.7)
Blood loss (mL)	120.0 ± 68.4
Operative time (min)	127.8 ± 39.9
Tumor size (cm)	1.6 ± 1.0
Histologic type	
Adenoid cystic carcinoma	11 (36.7)
Mucoepidermoid carcinoma	6 (20.0)
Carcinoid	9 (30.0)
Typical	8 (26.7)
Atypical	1 (3.3)
Inflammatory myofibroblastic tumor	3 (10.0)
Myoepithelioma	1 (3.3)
Resected margin	
Negative	22 (73.3)
Positive	8 (26.7)
Isolated positive proximal margin	3 (10.0)
Typical carcinoid	1 (3.3)
Adenoid cystic carcinoma	2 (6.7)
Both proximal and distal margin	5 (16.7)
Adenoid cystic carcinoma	5 (16.7)
Isolated positive distal margin	0
The length of bronchus resected (cm)	2.1 ± 0.9
For negative margins	2.1 ± 0.8
For positive margins*	2.3 ± 1.2
Lymph nodes metastasis	
Negative	28 (93.3)
Positive	2 (6.7)

Values are presented as n (%) or mean ± standard deviation. \*No significant difference in the length of the resected bronchus was observed between patients with negative and positive margins by Mann-Whitney *U* test (*P* = .696).

anastomotic complications were observed in this study, which may be explained by a limited sample size, good patient selection, careful detection of air leaks during the surgery, and surgeons experienced in performing complex bronchial anastomosis.

**TABLE 3. Postoperative results and follow-up outcomes of patients receiving left secondary carinal resection and reconstruction**

Variable	Overall (N = 30)
Operative complications	4 (13.3)
Subcutaneous emphysema	2 (6.7)
Prolonged Air leak	2 (6.7)
Pneumonia	3 (10.0)
Median duration of chest tube drainage (d)	5 (3-9)
Median length of hospital stay (d)	7 (4-15)
Postoperative adjuvant therapy	9 (30.0)
Radiotherapy	7 (23.3)
Chemoradiotherapy	2 (6.7)

Values are presented as n (%) or median (range).

Positive resected margins were confirmed in 8 patients (26.7%), whereas 7 of them were confirmed adenoid cystic carcinomas, which are reported to have a high margin positivity.<sup>10</sup> It has been reported that R1 resection followed by postoperative radiotherapy is a feasible alternative for adenoid cystic carcinomas with comparable overall survival to R0 resection.<sup>24,25</sup> Meanwhile, none of the 8 cases with positive margins in this study confirmed isolated positive distal margins and no significant difference was detected in the length of the resected bronchus between R0 and R1 resection ( $P = .696$ ), revealing that extended resections such as pneumonectomy or carinal pneumonectomy, might be necessary to achieve negative margins in these cases. Sometimes, R0 resection cannot be achieved even by pneumonectomy or carinal pneumonectomy, especially for adenoid cystic carcinomas.<sup>10</sup> We thus recommend left secondary carinal resection and reconstruction for low-grade malignancies due to the fact that sparing pulmonary parenchyma effectively preserves a patient's postoperative pulmonary function.

The present study has several limitations to be acknowledged. First, it was a retrospective study with inevitable biases. Second, the sample size in this study was still limited, although it included the cases from 2 centers. Thus, the results might be influenced by the experience of these centers in tracheobronchoplastic procedures. Third, longer follow-up is recommended for better evaluation of the therapeutic effectiveness of left secondary carinal resection and reconstruction.

## CONCLUSIONS

Left secondary carinal resection and reconstruction with total pulmonary parenchymal preservation is feasible for well-selected and oncologically appropriate patients with low-grade bronchial malignancies.

## Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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## References

1. Thomas CP. Conservative resection of the bronchial tree. *J R Coll Surg Edinb*. 1956;1:169-86.
2. Gaissert HA, Grillo HC, Shadmehr MB, Wright CD, Gokhale M, Wain JC, et al. Long-term survival after resection of primary adenoid cystic and squamous cell carcinoma of the trachea and carina. *Ann Thorac Surg*. 2004;78:1889-96.

3. Honings J, Gaissert HA, Weinberg AC, Mark EJ, Wright CD, Wain JC, et al. Prognostic value of pathologic characteristics and resection margins in tracheal adenoid cystic carcinoma. *Eur J Cardiothorac Surg*. 2010;37:1438-44.
4. Honings J, van Dijck JA, Verhagen AF, van der Heijden HF, Marres HA. Incidence and treatment of tracheal cancer: a nationwide study in the Netherlands. *Ann Surg Oncol*. 2007;14:968-76.
5. Maziak DE, Todd TR, Keshavjee SH, Winton TL, Van Nostrand P, Pearson FG. Adenoid cystic carcinoma of the airway: thirty-two-year experience. *J Thorac Cardiovasc Surg*. 1996;112:1522-31.
6. Lee JH, Jung EJ, Jeon K, Koh WJ, Suh GY, Chung MP, et al. Treatment outcomes of patients with adenoid cystic carcinoma of the airway. *Lung Cancer*. 2011;72:244-9.
7. Shadmehr MB, Farzanegan R, Graili P, Javaherzadeh M, Arab M, Pejhan S, et al. Primary major airway tumors; management and results. *Eur J Cardiothorac Surg*. 2011;39:749-54.
8. Zhao Y, Zhao H, Fan L, Shi J. Adenoid cystic carcinoma in the bronchus behaves more aggressively than its tracheal counterpart. *Ann Thorac Surg*. 2013;96:1998-2004.
9. Tang J, Cao M, Qian L, Fu Y, Tang J, Zhao X. The pure distal left main bronchial sleeve resection with total lung parenchymal preservation: report of two cases and literature review. *J Thorac Dis*. 2014;6:E294-8.
10. Yang H, Yao F, Tantai J, Zhao Y, Tan Q, Zhao H. Resected tracheal adenoid cystic carcinoma: improvements in outcome at a single institution. *Ann Thorac Surg*. 2016;101:294-300.
11. Ohta Y, Yachi T, Oda M, Sato H, Shimizu J, Watanabe Y, et al. Bronchial sleeve resection with complete preservation of the lung for carcinoma. *Respiration*. 2001;68:528-32.
12. Cerfolio RJ, Deschamps C, Allen MS, Trastek VF, Pairolero PC. Mainstem bronchial sleeve resection with pulmonary preservation. *Ann Thorac Surg*. 1996;61:1458-62.
13. Mantovani S, Gust L, D'Journo XB, Thomas PA. Left main bronchial sleeve resection with total lung parenchymal preservation: a tailored surgical approach. *Eur J Cardiothorac Surg*. 2020;57:596-7.
14. Martin-Ucar AE, Chaudhuri N, Edwards JG, Waller DA. Can pneumonectomy for non-small cell lung cancer be avoided? An audit of parenchymal sparing lung surgery. *Eur J Cardiothorac Surg*. 2002;21:601-5.
15. Yavuzer S, Yüksel C, Kutlay H. Segmental bronchial sleeve resection: preserving all lung parenchyma for benign/low-grade neoplasms. *Ann Thorac Surg*. 2010;89:1737-43.
16. Stevic R, Milenkovic B. Tracheobronchial tumors. *J Thorac Dis*. 2016;8:3401-13.
17. Bölükbas S, Schirren J. Parenchyma-sparing bronchial sleeve resections in trauma, benign and malign diseases. *Thorac Cardiovasc Surg*. 2010;58:32-7.
18. Lucchi M, Melfi F, Ribechini A, Dini P, Duranti L, Fontanini G, et al. Sleeve and wedge parenchyma-sparing bronchial resections in low-grade neoplasms of the bronchial airway. *J Thorac Cardiovasc Surg*. 2007;134:373-7.
19. Jiang X, Dong X, Zhao X, Peng C. Bronchial sleeve resection distal to the main bronchus with complete pulmonary preservation for benign or low-grade malignant tumors. *Ann Thorac Surg*. 2007;84:e19-21.
20. Tedder M, Anstadt MP, Tedder SD, Lowe JE. Current morbidity, mortality, and survival after bronchoplastic procedures for malignancy. *Ann Thorac Surg*. 1992;54:387-91.
21. Naruke T. Bronchoplastic and bronchovascular procedures of the tracheobronchial tree in the management of primary lung cancer. *Chest*. 1989;96:53S-6S.
22. Massard G, Kessler R, Gasser B, Ducrocq X, Elia S, Gouzou S, et al. Local control of disease and survival following bronchoplastic lobectomy for non-small cell lung cancer. *Eur J Cardiothorac Surg*. 1999;16:276-82.
23. Müller C, Schinkel C, Hoffmann H, Dienemann H, Schildberg FW. Bronchoplastic resection for non-small-cell lung cancer. *Thorac Cardiovasc Surg*. 1996;44:248-51.
24. Grillo HC, Mathisen DJ. Primary tracheal tumors: treatment and results. *Ann Thorac Surg*. 1990;49:69-77.
25. Wang Y, Cai S, Gao S, Xue Q, Mu J, Gao Y, et al. Tracheobronchial adenoid cystic carcinoma: 50-year experience at the National Cancer Center, China. *Ann Thorac Surg*. 2019;108:873-82.

**Key Words:** low-grade malignant bronchial tumor, sleeve resection, lung preservation, left secondary carinal reconstruction