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Case Report

Left Bronchial Sleeve Resection for Metastatic Typical Carcinoid: A Case Report and Literature Review

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Abstract: Background: Bronchial sleeve resection with complex reconstruction is a rare and intricate surgical procedure, particularly when addressing metastatic carcinoid tumors. This case report details the surgical management of a young male with a typical carcinoid tumor metastasized to the hilar and subcarinal lymph nodes. **Case Presentation:** A 28-year-old medically fit male presented with cough and occasional blood-tinged sputum for 2 months that was diagnosed to be due to a typical carcinoid tumor involving the left main bronchus, with metastasis to the hilar and subcarinal lymph nodes. The patient underwent a left bronchial sleeve resection with complex reconstruction of the left lower lobe bronchus. The reconstructed bronchus was then anastomosed to the main bronchus followed by hilar and subcarinal lymph nodes dissection. The surgical approach aimed to preserve lung parenchyma while ensuring complete tumor resection. Postoperative recovery was uneventful, with the patient demonstrating satisfactory respiratory function. Histopathological examination confirmed the complete resection of the carcinoid tumor and metastatic lymph nodes (hilar and inter-lobar LN (positive 2/5) and subcarinal LN (positive 1/6)). The patient had no signs of recurrence at the 3-month follow-up. **Conclusions:** This case highlights the feasibility and effectiveness of bronchial sleeve resection with bronchial reconstruction in managing metastatic carcinoid tumors. The successful outcome underscores the importance of meticulous surgical planning and execution in achieving favorable results in complex thoracic surgeries.

Keywords: bronchial sleeve resection; bronchial reconstruction; metastatic carcinoid tumors; hilar and subcarinal metastasis

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1. Introduction

Typical carcinoid tumors are a subset of neuroendocrine tumors that are generally slow-growing and often found in the central airways. Despite their indolent nature, these tumors can metastasize to regional lymph nodes, complicating surgical management. The gold standard for treating bronchial carcinoid tumors is surgical resection, which aims to completely remove the tumor while preserving as much lung function as possible [1].

Bronchial sleeve resection is a complex surgical technique that allows for the removal of tumors involving the bronchus while sparing lung parenchyma. This procedure involves dissecting the affected bronchus free of adjacent tissue and transecting it with a knife to ensure straight margins. After the tumor is removed, both bronchial margins are examined by frozen section to confirm a radical resection. If any margin is positive, an additional bronchus must be resected [2]. The anastomosis construction depends on whether the

bronchus is approached from the anterior or posterior side. Intraoperative management typically includes airway management with a double lumen tube or endobronchial balloon blockers to achieve one-lung ventilation. Bronchial sleeve resection is particularly beneficial for younger patients and those with limited pulmonary reserve [3]. The bronchoplasty procedure, as a parenchyma-sparing surgery, was first introduced by Sir Prince Thomas in 1947, while sleeve lobectomy for lung cancer was performed by Allison in 1952 [4,5]. In cases where the tumor has metastasized to the hilar and subcarinal lymph nodes, achieving clear surgical margins becomes even more challenging [6].

This case report describes a young male who underwent a left bronchial sleeve resection with complex reconstruction of the left lower lobe bronchus, followed by anastomosis to the main bronchus. The unique aspect of this case is the presence of a typical carcinoid tumor with metastasis to the hilar and subcarinal lymph nodes, necessitating an intricate surgical approach to ensure complete resection and optimal patient outcomes.

2. Case Report

A 28-year-old medically fit male presented with persistent cough and occasional blood-tinged sputum for 2 months. Imaging studies, including a chest X-ray followed by a chest computed tomography (CT) scan revealed a mass in the left main bronchus with involvement of the left lower lobe bronchus, and metastasis to the hilar and subcarinal lymph nodes. Bronchoscopy revealed a well-defined ovoid mass partially obstructing part of the bronchial lumen and confirmed the mass extensions. It is smooth, pink-to-red in color with a shiny surface with inflamed bronchial mucosa around the mass. The findings suggested the possibility of sleeve bronchial resection. Biopsies were taken from the bronchial mass for histopathological examination and revealed typical carcinoid tumor (Figure 1, Supplementary Figure S1 and Table S1). The preoperative blood work, as full blood count, kidney and liver function, and pulmonary function tests, was normal. Patient does not have relevant past history or family history of cancer.

Under general anesthesia, the patient underwent a left mainstem bronchial sleeve resection with pulmonary preservation and reconstruction in addition to hilar and subcarinal lymph nodes dissection (Table 1).

Regarding the operative technique, after a double-lumen endotracheal intubation, a posterolateral thoracotomy was performed. The inferior pulmonary ligament was dissected in order to release the bronchial stump and avoid any tension. The left main bronchus was isolated and mobilized by carefully dissecting it free from surrounding tissues. This was achieved by approaching the bronchus from the dorsal side, which allowed for better visualization and access. To retract the pulmonary artery, we used a combination of gentle retraction with vascular loops and careful dissection to avoid injury. This provided adequate exposure of the bronchus for resection and reconstruction. The lymph node dissection was performed prior to the bronchial resection. This approach facilitated the better isolation and mobilization of the bronchus by removing the lymph nodes that could potentially interfere with the surgical field. The hilar and subcarinal lymph nodes were meticulously dissected and sent for pathological examination. The left main bronchus was dissected, and the proximal and distal lines of transection were determined under bronchoscopy guidance. Full-thickness traction sutures of Prolene were placed proximally and distally in the bronchus in order to reduce tension during the suture. The surgical procedure entailed the resection of the left main bronchus, along with part of the lower lobe bronchus. Additionally, the safety margin of the left main bronchus was performed to ensure clear margins. The remaining bronchial stumps were meticulously reconstructed and anastomosed to the main bronchus using a running suture for the membranous wall, and interrupted Prolene 3-0 stitches and pericardial fat wrapping were used to prevent

the occurrence of bronchovascular fistula. After the sutures' completion and lung re-expansion, air leak testing using a saline-filled pleural cavity was performed. Intraoperative bronchoscopy examination confirmed the good quality of the bronchial suture and the proper patency of the airway.

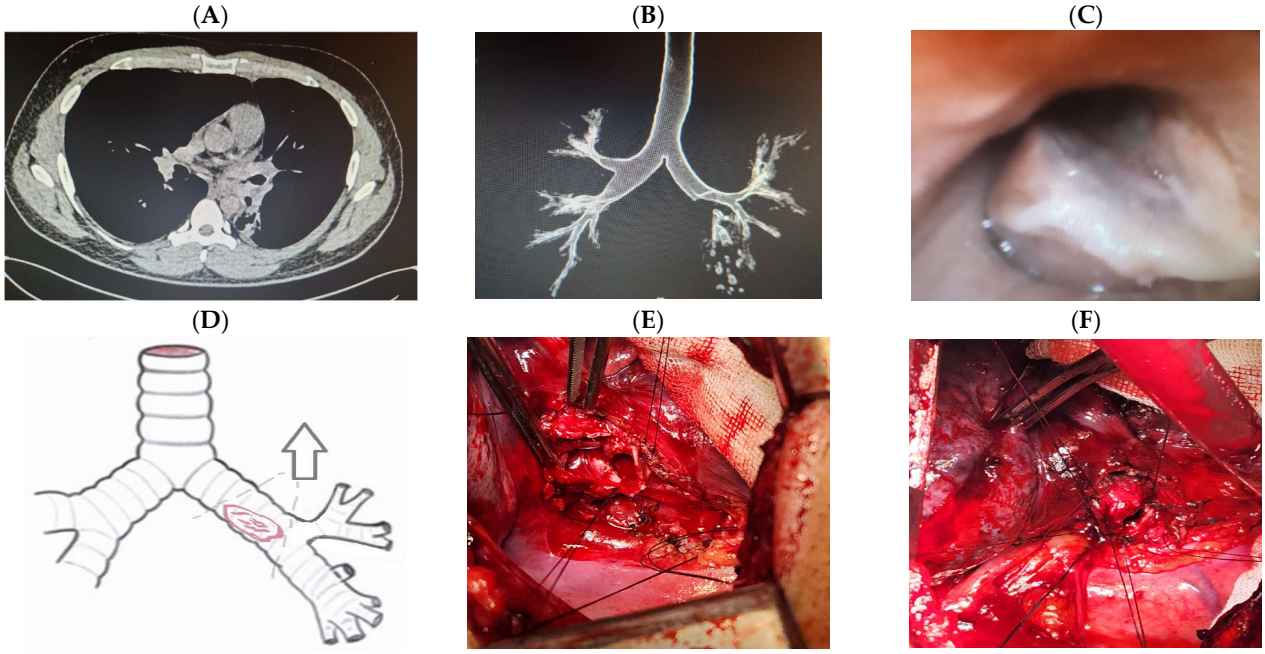


Figure 1. Details of our case: (**A**) computed tomography (CT) showing mass in the left main bronchus with hilar and mediastinal nodal metastases; (**B**) 3D reconstruction of CT scan of the airways, showing a missed segment of the left lower bronchus with distal consolidation patches; (**C**) preoperative bronchoscopy showing ovoid mass in the left bronchus; (**D**) diagrammatic illustration of the mass and the operation other than excised lymph nodes; (**E**) intraoperative resected airways; and (**F**) reconstructed airways.

The patient tolerated the surgery well, with no intraoperative complications. The operative time was 130 min, and the estimated blood loss was around 120 cc, without any need for blood transfusion.

Postoperative recovery was uneventful, and the patient was extubated on the first postoperative day. He was discharged on the fifth postoperative day, with satisfactory respiratory function.

Histopathological examination confirmed the diagnosis of a typical carcinoid tumor. The tumor cells were arranged in nests and trabeculae, with uniform round nuclei and moderate and eosinophilic cytoplasm. Mitotic figures were rare (1 mitosis per 10 high-power fields), and there was no necrosis. The tumor infiltrates the full thickness of the bronchial wall cartilage and infiltrates the adjacent lung tissue. There was evidence of lymphovascular invasion. Immunohistochemistry showed strong positivity for chromogranin A and synaptophysin, confirming the neuroendocrine nature of the tumor. There was a low proliferative index ((Ki-67) < 5%). The resected lymph nodes also showed metastatic carcinoid tumor cells (hilar and inter-lobar LN (two out of five positive) and subcarinal LN (one out of six positive)). The tumor stage was pT2a, pN2, see the Supplementary Table S1.

At the 3-month follow-up, the patient remained asymptomatic, with no signs of recurrence on imaging studies.

3. Discussion

Bronchial sleeve resection is a valuable surgical technique for managing central airway tumors while preserving lung parenchyma. This case highlights the feasibility and effectiveness of this approach in a young patient with a typical carcinoid tumor and lymph node metastasis. The successful outcome underscores the importance of meticulous surgical planning and execution.

The histopathological and immunohistochemical findings were consistent with a typical carcinoid tumor. The absence of necrosis and low mitotic rate are characteristic features of typical carcinoids, distinguishing them from atypical carcinoids and other high-grade neuroendocrine tumors. Immunohistochemistry plays a crucial role in confirming the diagnosis and guiding management.

The operative time for our case was 130 min. He tolerated the surgery well and had a smooth early postoperative course. The reported operative time and mortality based on recent meta-analysis that included 655 patients and compared video-assisted thoracoscopic versus open sleeve lobectomy for non-small cell lung cancer were 192.58 ± 61.35 min and 3.8% [7].

There are different surgical bronchial anastomosis techniques that have been thoroughly reported in a prior paper on bronchial anastomosis in lung transplantation: (i) running suture for the membranous wall and interrupted suture for cartilaginous parts; (ii) single running or continuous suture; (iii) figure-of-eight suture; (iv) continuous two-stitch suture; and (v) telescoping suture [8]. In our case, we used a running suture for the membranous wall and interrupted Prolene 3-0 stitches.

Based on a prior series from the Surveillance, Epidemiology, and End Results (SEER) database, the incidence of N1 and N2 metastases were 6 and 3.4% in typical carcinoid versus 13 and 16% in atypical carcinoid, respectively, signifying the rate incidence of nodal metastasis in typical carcinoids [9].

Table 1. Studies with mainstem bronchial sleeve resection with pulmonary preservation for neoplasms from a single institution.

Author/Year	City/Country	Period	No. of Patients	Gender (Male/Female)	Laterality (Rt/Lt)	Age (Range)	Indications (Carcinoid)	Indications (Others)	Morbidity/Hospital Mortality
Stamatis, 1990 [10]	Essen/ Germany	1968–1988	227 (4a)	112/115(?a)	? (?a)	? (14–79)	227	0	2/0.44
Newton, 1991 [11]	Boston/ USA	1975–1991	27_a	$17/9_a$	$8/19_a$	35 $(20–65)_a$	Nine	MEC: two; FM: two; ST: two; O: two; HP: one; NSCLC: one	15/0
Schepens, 1994 [12]	Nieuwegein/ Netherlands	1974–1993	17 (8_a)	$6/11(?_a)$	12/6 ($3/5_a$)	38 (22–59)	17	0	0/0
Cerfolio, 1996 [13]	Rochester/MN/ USA	1965–1995	22a	13/9a	12/10a	37 (12–70)a	Nine	ST: five; MEC: three; NSCLC: two; BL: two; ACC: one	14/0

Table 1. *Cont.*

Author/Year	City/Country	Period	No. of Patients	Gender (Male/Female)	Laterality (Rt/Lt)	Age (Range)	Indications (Carcinoid)	Indications (Others)	Morbidity/Hospital Mortality
Lucchi, 2007 [14]	Pisa/Italy	1980–2006	26 (7_a)	17/9($?_a$)	12/9_b ($3/4_a$)	49 (19–74)	18	MEC: two; ACC: one; CH: two; H: one; M+: one; G: one	8/0
Ragusa, 2012 [15]	Perugia/Italy	1995–2011	4a	1/3a	$0/4_a$	? $(25–65)_a$	2	P: one; ST: one	0/0
Nowak, 2013 [16]	London/UK	2000–2010	13 (5_a)	10/3($?_a$)	11/2 ($3/2_a$)	45 (16–69)	13	0	0/0
Zhu, 2021 [17]	Suzhou/China	2013-2021	54°	50/4	31/23	61.2 (36-80)	1	SCC: 43; ADC: 4; MEC: 2, M+: 1; Others: 3	46.3/0

ACC, adenoid cystic carcinoma; BL, broncholith; C, carcinoid tumor (including typical and atypical types); CH, chondroma; FH, fibrous histiocytoma; G, glomic tumor; H, hamartoma; HP, hemangiopericytoma; MEC, mucoepidermoid carcinoma; M+, metastasis (melanoma); NSCLC, non-small cell lung carcinoma; O, other tumors; P, inflammatory pseudotumor; ST, stricture. a Patients with resection of mainstem bronchus only. b Five patients with resection of main carina excluded. "?" indicates the number of patients with resection of mainstem bronchus only was not stated in the referred publication.

4. Strengths and Limitations

One of the strengths of this case is the successful application of a complex surgical technique to achieve complete tumor resection while preserving lung function. The use of additional safety margin ensured clear surgical margins, contributing to the favorable outcome. Hilar and mediastinal nodal dissection should be considered in the presence of clinically enlarged nodes, even in typical carcinoid cases and with sleeve resection.

However, there are limitations to this case. The follow-up period is relatively short, and a longer follow-up is necessary to assess long-term outcomes and any possible recurrence. Additionally, while the patient had no immediate postoperative complications, the long-term impact on pulmonary function and quality of life remains to be fully evaluated.

5. Conclusions

This case report demonstrates the successful management of a typical carcinoid tumor with metastasis to the hilar and subcarinal lymph nodes using bronchial sleeve resection and bronchial reconstruction. The favorable outcome emphasizes the importance of a multidisciplinary approach and meticulous surgical technique in achieving optimal results in complex thoracic surgeries.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/std14010003/s1, Table S1: Histopathological examination report of our case report. Table S2: Bronchoplasty and sleeve resection [8,18,19]. Table S3: CARE Checklist. Figure S1: Gross appearance of the resected tumor and bronchial wall.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy and ethical restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

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