



## The Role of Sleeve Bronchial Resection in the Treatment of Lung Cancer

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### Abstract

Sleeve resection was first introduced in 1947 by Prince-Thomas. Allison in 1959 reported first sleeve lobectomy with pulmonary artery construction. With this technique is removed a lung tumor in a lobe of the lung and a part of the main bronchus. The ends of the bronchus are rejoined and any remaining lobes are reattached to the bronchus. Sleeve lobectomy was considered inferior to pneumonectomy, but work by Ferguson., et al. and Deslauriers., et al. showed that sleeve lobectomy has better outcome and lower morbidity and mortality as compared to pneumonectomy. Sleeve lobectomy for lung cancer is an established technique and has been widely used with safety. We present 5 cases to discuss the surgical strategy for sleeve resection of the central airway.

**Case Series:** In the last years we have performed with very good results five bronchial sleeve resections and two semi sleeve bronchial resections for lung cancer with histopathologic diagnosis squamous carcinoma, typical carcinoid with excellent results without any complication. The mean hospital day after surgery was 6 days and all the patients left the hospital in very good conditions.

**Case 1:** Patient 64 years old where a Sleeve Lobectomy of Right Upper Lobe was performed for Epidermoid Carcinoma in the Entrance of Bronchus of the Right Upper Lobe.

**Case 2:** Patient 67 years old where a Sleeve Resection of the Right Upper Lobe was performed for Epidermoid Carcinoma in the Entrance of Bronchus the Right Upper Lobe and COPD with FEV1 62%.

**Case 3:** Patient 61 years old where a Semi Sleeve Resection of the Left Upper Lobe was performed for Epidermoid Carcinoma in the Bronchus of the Left Upper Lobe.

**Case 4:** Patient 56 years old where a Semi Sleeve Resection of the Right Lower Lobe was performed for Epidermoid Carcinoma in the Bronchus of the Right Lower Lobe after 3 cycles of Neoadjuvant Chemotherapy.

**Case 5:** Patient 35 years old where a Sleeve Resection of the Left Upper Lobe was performed for Carcinoid in the Entrance of Bronchus of the Left Upper Lobe.

**Keywords:** Sleeve Resection; Lobe; Lung Cancer; Bronchus

### Introduction

Pulmonary sleeve resection is a type of complex lung resection and reconstruction surgery typically performed for patients with locally advanced lung cancer that involves central airways or vascular structures. Pulmonary sleeve resection (PSR) is a broad term to describe circumferential excision of a part of the bronchus and/or pulmonary vessels during lung parenchyma resection while preserving the uninvolved portions of the lung. Bronchoplasty or vascular reconstructions are incorporated techniques where the two separate pieces of remaining bronchus or vessels are re-anas-

tomosed. The most common indication is for lung neoplasm. The indication for a sleeve resection for lung cancer is well established: a tumor arising at the origin of a lobar bronchus precluding simple lobectomy, but not infiltrating as far as to require pneumonectomy. Bronchial sleeve lobectomy is reported to be adequate for 5% to 8% of patients with resectable lung cancer but rates as high as 13% have been reported recently.

### Our experience

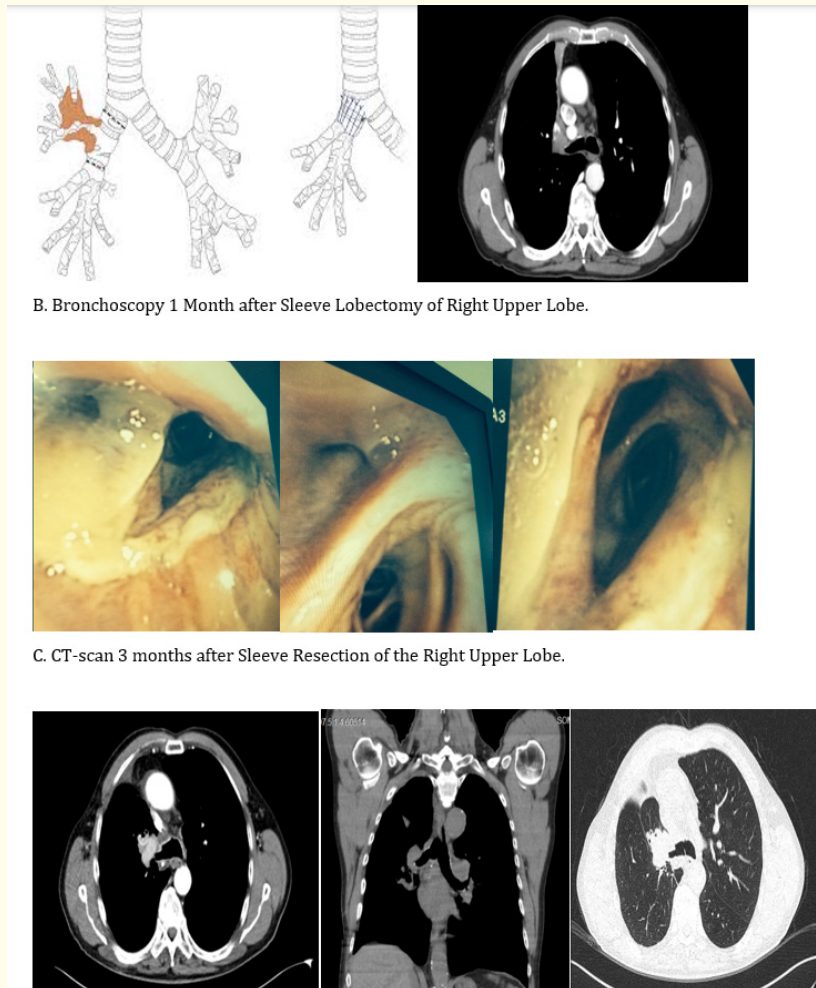
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tions for lung cancer with histopathologic diagnosis squamous carcinoma typical characinoid with excellent results without any complication. The mean hospital day after surgery was 6 days and all the patients left the hospital in very good conditions.

**Case 1**

A male patient of 64 years old refers a 3 months history of dysnea, cough, fatigue and weight waist of 10 kg, admited with the diagnosis: Right Hilar Lung mass to be determined. On phy-

sical examination, nothing abnormal to date. On his past medical history, he referred: hypertension treated correctly and diabetes on oral antidiabetics. On angiography CT- scan total body result, it is seen: A mass on the entrance of the right upper lobe bronchus, no metastases lung or distant, no lymphadenopathy. A spirometry was performed with results within the normal range. A biopsy through the fibrobronchoscope was done and its result was Epidermoid Carcinoma in the Entrance of Bronchus of the Right Upper Lobe and then Sleeve Lobectomy of Right Upper Lobe was performed.



B. Bronchoscopy 1 Month after Sleeve Lobectomy of Right Upper Lobe.

C. CT-scan 3 months after Sleeve Resection of the Right Upper Lobe.

**Figure 1**

**Case 2**

A male patient of 67 years old refers a 1 month history of dysnea, cough with haemosputum, fatigue and weight waist of 6 kg, admited with the diagnosis: Right upper lobe lung mass to be determined. On physical examination, on pulmonary auscultation it is noticed diminished bilateral vesicular lung sounds. On his past medical history, he referred: hypertension treated correctly

and COPD treated with inhalers Indacaterole/Glycopyrronium. On angiography CT- scan total body result, it is seen: A mass on the entrance of the right upper lobe bronchus, no metastases lung or distant, no lymphadenopathy. A spirometry was performed and its result was Obstructive syndrome with FEV1 62%. A biopsy through the fibrobronchoscope was done and its result whas Epidermoid Carcinoma in the Entrance of Bronchus of the Right Upper Lobe and then Sleeve Lobectomy of Right Upper Lobe was performed.

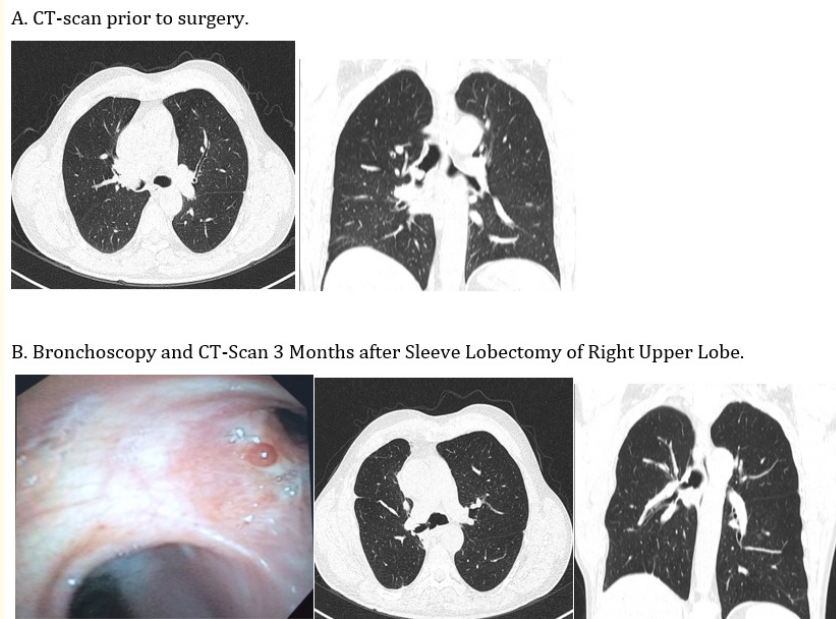


Figure 2

**Case 3**

A female patient of 61 years old refers a 2 months history of dysnea, productive cough, fatigue and weight waist of 4 kg, admitted with the diagnosis: Left upper lobe Lung mass to be determined. On physical examination, nothing abnormal to date. On his past medical history, she referred: hypertension, hypothyroidism treated with levothyroxine. On angiography CT- scan total body

result, it is seen: A mass on the entrance of the left upper lobe bronchus, no metastases lung or distant, no lymphadenopathy. A spirometry was performed with results within the normal range. A biopsy through the fibrobronchoscope was done and its result was Epidermoid Carcinoma in the Entrance of Bronchus of the left Upper Lobe and then Sleeve Lobectomy of Left Upper Lobe was performed.

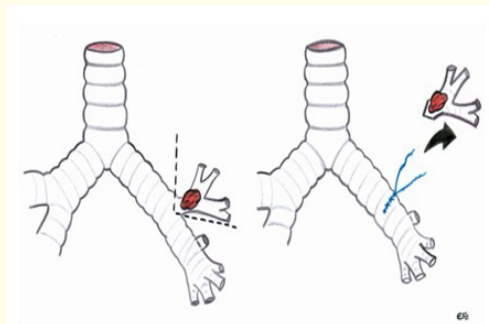


Figure 3: Semi Sleeve Resection of the Left Upper Lobe.

**Case 4**

A male patient of 56 years old refers a 3 months history of dysnea, productive cough sometimes with haemosputum, fatigue and weight waist of 15 kg, admitted with the diagnosis: Right lower lobe lung mass to be determined. On physical examination, nothing abnormal to date. On his past medical history, she referred: hypertension, hypothyroidism treated with levothyroxine. On angio-

graphy CT- scan total body result, it is seen: A mass on the entrance of the right lower lobe bronchus, no metastases lung or distant, no lymphadenopathy. A spirometry was performed with results within the normal range. A biopsy through the fibrobronchoscope was done and its result was Epidermoid Carcinoma in the Entrance of Bronchus of the Right lower Lobe and after 3 cycles of Neoadjuvant Chemotherapy, Sleeve Lobectomy of Right lower Lobe was performed.



Figure 4: CT-scan 3 months after Semi Sleeve Resection of the Left Upper Lobe.

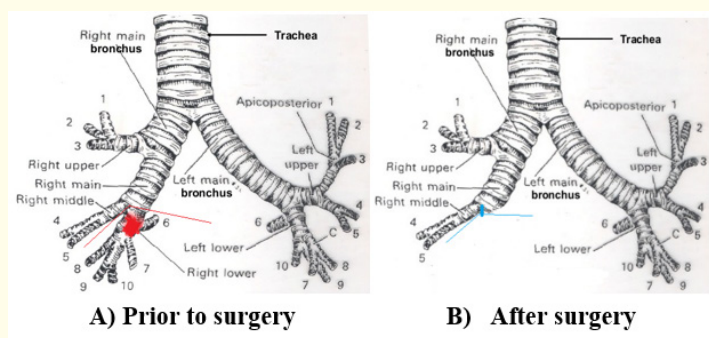


Figure 5: Semi Sleeve Resection of the Right Lower Lobe.



Figure 6: CT-scan 3 months after Semi Sleeve Resection of the Right Lower Lobe.

**Case 5**

A male patient of 35 years old refers a 2 months history of dysnea, productive cough s, fatigue and weight waist of 6 kg, admitted with the diagnosis: Left upper lobe lung mass to be determined. On physical examination, on pulmonary auscultation it is noticed diminished vesicular lung sounds. On his past medical history, nothing important. On angiography CT- scan total body result, it is seen: A mass on the entrance of the left lower lobe bronchus, no metastases lung or distant, no lymphadenopathy. A spirometry was performed with results within the normal range. A biopsy through the fibrobronchoscope was done and its result was Carcinoid in the Entrance of Bronchus of the Left Upper Lobe and Sleeve Lobectomy of Left upper Lobe was performed.

**Discussion**

Sleeve resection was first introduced in 1947 by Prince-Thomas. Allison in 1959 reported first sleeve lobectomy with pulmonary artery construction. With this technique is removed a lung tumor in a lobe of the lung and a part of the main bronchus. The ends of the bronchus are rejoined and any remaining lobes are reattached to the bronchus. Sleeve lobectomy was considered inferior to pneumonectomy, but work by Ferugson., *et al.* and Deslauriers., *et al.* showed that sleeve lobectomy has better outcome and lower morbidity and mortality as compared to pneumonectomy [1-5].

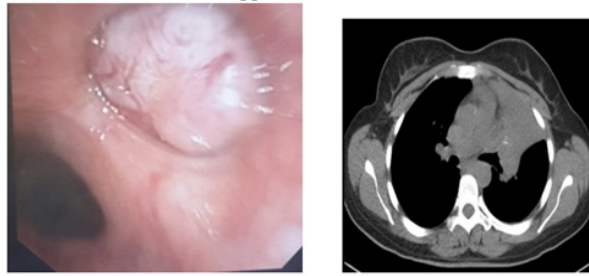


Figure 7: Carcinoid in the Entrance of Bronchus of the Left Upper Lobe.

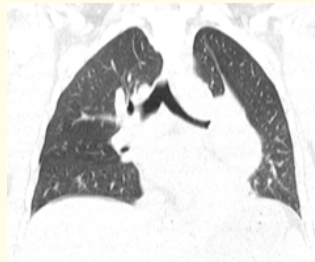


Figure 8: CT scan prior to surgery.

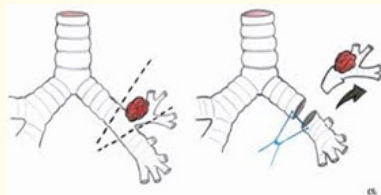


Figure 9: Sleeve Resection of the Left Upper Lobe.

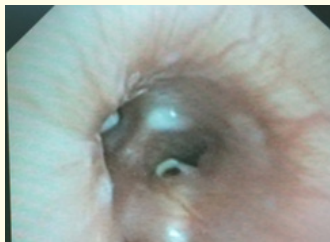


Figure 10: Bronchoscopy 3 Months after Sleeve Lobectomy of Left Upper Lobe.

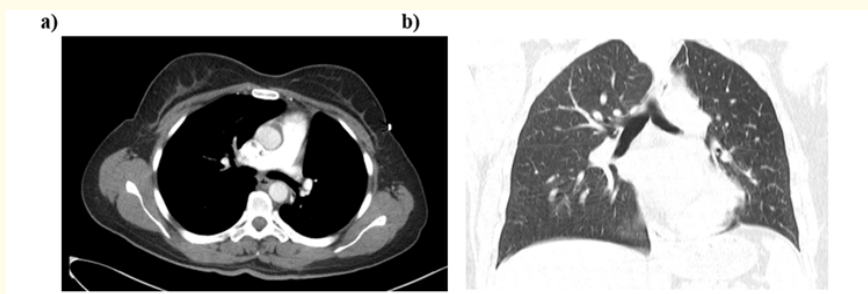


Figure 11: CT-scan 3 months after Semi Sleeve Resection of the Left Upper Lobe.

The indication for a sleeve resection for lung cancer is well established: a tumor arising at the origin of a lobar bronchus precluding simple lobectomy, but not infiltrating as far as to require pneumonectomy. Bronchial sleeve lobectomy is reported to be adequate for 5% to 8% of patients with resectable lung cancer but rates as high as 13% have been reported recently. It is important to point out that this increased rate of sleeve lobectomy is achieved at

the expense of a decreased incidence of pneumonectomy and not of lobectomy, while the oncologic results remain unchanged [6-8].

From a functional point of view, sleeve lobectomy is strictly indicated in patients who cannot withstand pneumonectomy, but recent experiences have shown that the advantages of sparing one lung lobe are evident also in patients without cardio-pulmonary impairment [9,10].

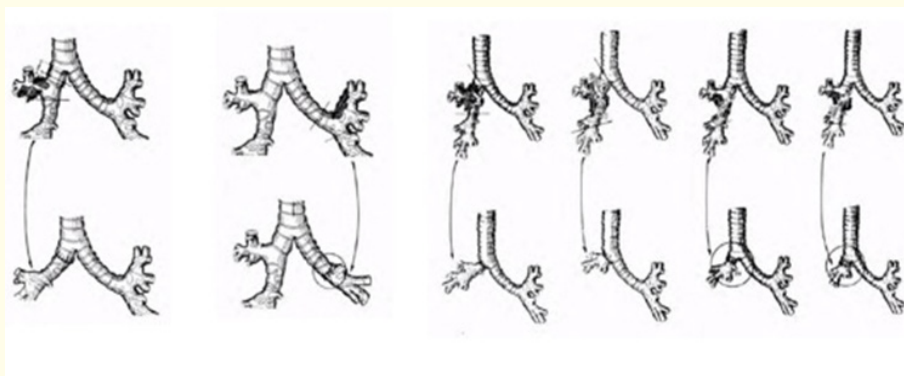


Figure 12: Types of Bronchosleeve Resection.

Oncologically, the primary goal of surgery is complete resection of lung cancer with adequate resection margins free of tumor. This is all the more true for carcinoid tumors or benign lesions. These considerations apply also to patients with nodal involvement limited to hilar lymph nodes (N1) [11,12].

#### Indications [13,14]

- Tumor invading/protruding main stem bronchus
- As an alternative to pneumonectomy in patients with poor cardiopulmonary reserve
- Endobronchial bronchogenic carcinoma
- Carcinoid tumors and low-grade malignancy like bronchial gland carcinomas if complete resection can be obtained

#### Contraindications [13,14]

- Complete resection of tumor not achievable by bronchovascular sleeve resection
- N2 disease (a relative contraindication)

#### Early complications

- Atelectasis and pneumonia are the most common postoperative complications and occur in 5-10% of cases.
- Persistent air leak and anastomotic dehiscence occur in 1-7% of cases. These complications result from ischemia of the anastomosis.

Bronchopleural fistula occurs in 1-7% of cases. It carries a high mortality in the range of 14-70%. Risk factors for development of bronchopleural fistula include:

- Residual cancer tissue at the stump,
- Preoperative radiotherapy,
- Diabetes,
- Long bronchial stump,
- Prolonged mechanical ventilation,
- Pneumonia.

If it is small, conservative management with antibiotics and complete drainage can be attempted. But if repair is impossible, then complete pneumonectomy is required [1-4,15].

- Hemothorax most commonly results from inadequate hemostasis. This complication is seen in 1-2 days postoperatively.
- Empyema can occur immediately in the postoperative period but can develop after months to years. It requires treatment with drainage and antibiotics.
- Bronchovascular fistula results from anastomotic breakdown. The incidence is 0.9-7%. If bronchovascular fistula is found, then completion pneumectomy should be performed.
- Vascular thrombosis and ischemic necrosis can occur at the site of reconstruction. They can be avoided by adequate heparinization intraoperatively and anticoagulation postoperatively.

- Pulmonary edema is less common as compared to pneumonectomy. It can be caused by excessive fluid administration during surgery. But it can also be due to intraoperative myocardial infarction, sepsis, or transfusion-related lung injury. It manifests as rapidly developing pulmonary infiltrates, shortness of breath, and hypoxemia.
- Wound infection requires antibiotic and proper wound care [1,3-6].

### Late complications

Bronchial stenosis results from ischemia of bronchial anastomosis and granulation tissue. The incidence rate varies from 2.5-18%. The patient may be asymptomatic or may present with recurrent infection, shortness of breath, or atelectasis. Treatment involves balloon and bougie dilatation of the anastomosis. If balloon dilation fails, then re-do surgery can be attempted after 3 months when the inflammation has subsided. However, a completion pneumonectomy is required if re-do surgery is impossible [11-14].

### Recurrent malignancy

Is a late complication. Local recurrence rate has been reported between 9-24% [11-14].

### Mortality

Operative mortality has been described in up to 6% of patients [11-14].

### Acknowledgements

None declared.

### Conflict of Interest Statement

The authors have nothing to disclose with regard to commercial support.

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