

# Left carinal pneumonectomy through median sternotomy: Surgical experience of two patients

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## ABSTRACT

Endobronchial tumors infiltrating the carina is a formidable challenge to surgeons in view of difficult surgical access to the carina, especially on the left side, problems of securing the airway intra-operatively, technically challenging anastomosis due to anatomical location, and high post-operative morbidity and mortality. We present our surgical experience of two cases of left carinal pneumonectomy which was undertaken for resectable primary salivary gland type tumors of lung.

**KEY WORDS:** Lung neoplasms, pneumonectomy, sternotomy, thoracotomy, trachea

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## INTRODUCTION

There is a limited literature available about carinal resections in malignant endobronchial tumors; majority of these tumors, when they involve the carina, also infiltrate the adjacent vital organs like heart or great vessel, and make them unsuitable for surgical resection. Primary salivary gland type endobronchial tumors are slow-growing tumors and are usually resectable even when they infiltrate the carina. Endobronchial tumors infiltrating the carina is a surgical challenge to surgeons in view of difficult surgical access to the carina especially on the left side, problems of securing the airway intra-operatively, technically challenging anastomosis due to anatomical location, and high post-operative morbidity and mortality. Left carinal pneumonectomy has been rarely described in literature in view of limited exposure caused by left sided aortic arch and early infiltration of sub-aortic space. We present our surgical experience of two cases of left carinal pneumonectomy which was undertaken for resectable primary salivary gland type tumors of lung.

## CASE REPORT

### Case 1

A 45-year-old gentleman presented with left-sided chest pain, cough, hemoptysis and progressive dyspnea of 2-years duration. Fiberoptic bronchoscopy showed an endobronchial lesion in left main bronchus extending 1 cm proximal to carina, the lesion was 2 cm proximal to left secondary carina; right main bronchus and lobar bronchi were normal. Contrast-enhanced computed tomography (CECT) of chest with virtual bronchoscopy revealed a polypoidal growth measuring 1.8 × 1.5 × 1.2 cm in the left main bronchus extending into carina, the secondary division was 2.8 cm distal to the mass [Figure 1]. Pulmonary function test showed FEV1 of 1.43 liters (49% of predicted), FVC of 1.63 litres (47% of predicted) and FEV1/FVC of 88.02%. Bronchoscopic-guided biopsy confirmed low-grade muco-epidermoid carcinoma. He was planned for carinal resection through median sternotomy. He was intubated with single-lumen endotracheal tube. After median sternotomy, anterior and posterior pericardium was opened; superior vena cava (SVC) was isolated and retracted towards right side, aortic arch was looped and retracted toward left while right pulmonary artery was pulled down. Carina was gently dissected and both right and left bronchi were also looped. The tumor was palpable till 2 cm proximal to secondary division; in order to achieve R'O' resection and inability to achieve tension-free anastomosis between left bronchus and trachea, surgical plan was changed to left carinal pneumonectomy. We planned to resect the carina followed

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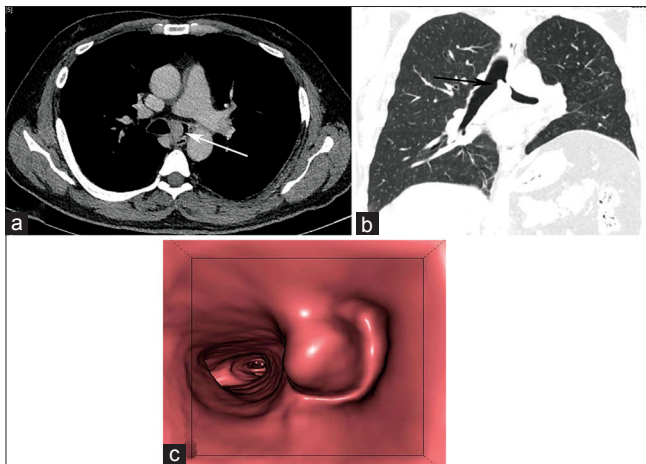
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by intubation of the left main bronchus while anastomosis between right main bronchus and trachea was completed. We divided the carina and left main bronchus keeping 1-cm tumor-free margin. We tried to intubate the remaining left bronchus with a sterile flexo-metallic endotracheal tube through surgical field; however, the length of the remaining left bronchus was too small to accommodate the tube. We, then, ventilated the patient through right main bronchus. Patient was placed on cardio-pulmonary bypass (CPB); ventilation was switched off and anastomosis between the right main bronchus and trachea was completed with PDS 4-0 interrupted sutures. Once the anastomosis was completed, a conventional flexo-metallic single lumen endotracheal tube was re-inserted and CPB was reversed. Left pneumonectomy was completed through the same sternotomy wound. To avoid any untoward tension on the anastomotic site the chin of the patient was sutured to the anterior chest wall ensuring a slight flexion at the neck. The patient was extubated 2 hours later after hemodynamic stabilization. On first postoperative day, he had high pericardial drain bleeding, tachycardia, and hypotension. He was explored; there was pericardial margin bleeder that was controlled. Post re-exploration, he developed pneumonia that gradually worsened. He succumbed to sepsis and multi-organ failure on 7<sup>th</sup> post-operative day. Histopathological examination of the resected specimen confirmed low-grade muco-epidermoid carcinoma; all the margins were tumor-free.

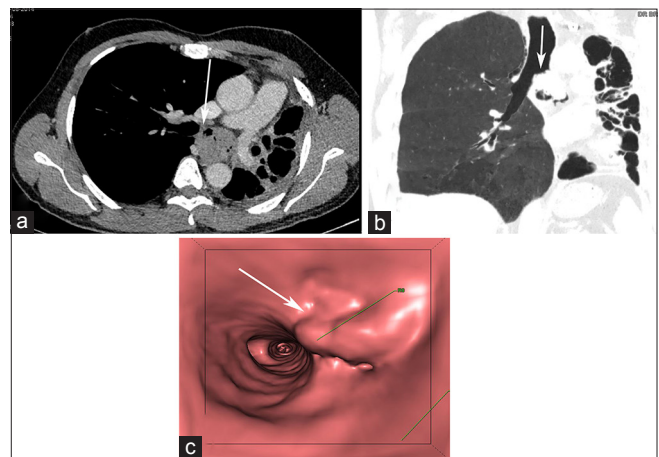
## Case 2

A 50-year-old gentleman presented with cough, hemoptysis and progressive dyspnea of 4 years duration. Fiberoptic bronchoscopy showed an endobronchial polypoidal lesion in left main bronchus; the lesion was completely occluding the bronchial lumen and was extending 1 cm above carina. Right main bronchus and lobar bronchi were normal on bronchoscopy. CECT of chest with virtual bronchoscopy revealed a well-defined homogenously

enhancing soft tissue mass measuring  $3.6 \times 3.1$  cm seen in left peri-bronchial location; the mass had intraluminal component in left main bronchus and was extending into the tracheal bifurcation. There were fibro-bronchiectatic changes in the left lung with volume loss; however, right lung was normal [Figure 2]. Pulmonary function test showed FEV1 of 1.58 l (52% of predicted), FVC of 2.44 l (66% of predicted) and FEV1/FVC of 64.55%. Bronchoscopy-guided biopsy confirmed adenoid cystic carcinoma. He was planned for left carinal pneumonectomy through median sternotomy. He was intubated with single-lumen endotracheal tube. After median sternotomy, anterior and posterior pericardium was opened; SVC was isolated and retracted toward right side, aortic arch was looped and retracted toward left while right pulmonary artery was pulled down. Carina was gently dissected and both right and left bronchi were also looped. He was placed on CPB; ventilation was switched off. Trachea was divided 2.5 cm above the carina and right bronchus was divided 1.5-cm beyond carina; anastomosis between the right main bronchus and trachea was completed with PDS 4-0 interrupted sutures. Once the anastomosis was completed, a conventional flexo-metallic single lumen endotracheal tube was reinserted and CPB was reversed. The left lung was adherent densely to the parieties and heart was also deviated to the left side. In order to facilitate the delivery of specimen underneath the arch of aorta and to completely mobilize the left lung, a transverse anterior thoracotomy was made through 4<sup>th</sup> inter-costal space. After the left carinal pneumonectomy specimen was delivered, thoracotomy and median sternotomy wounds were closed over left thoracic tube drainage. To avoid any untoward tension on the anastomotic site the chin of the patient was sutured to the anterior chest wall ensuring a slight flexion at the neck. The patient was extubated 4 hours later after hemodynamic stabilization. His postoperative period was



**Figure 1:** Case 1 (a) Axial CT section of chest shows the intraluminal mass (white arrow) at the origin of the left main bronchus (b) Minimal intensity projection reconstructed coronal image depicts the mass (black arrow) obstructing the left main bronchus with resultant volume loss of left lung (c) CT virtual bronchoscopy image reveals the mass projecting in the left main bronchus

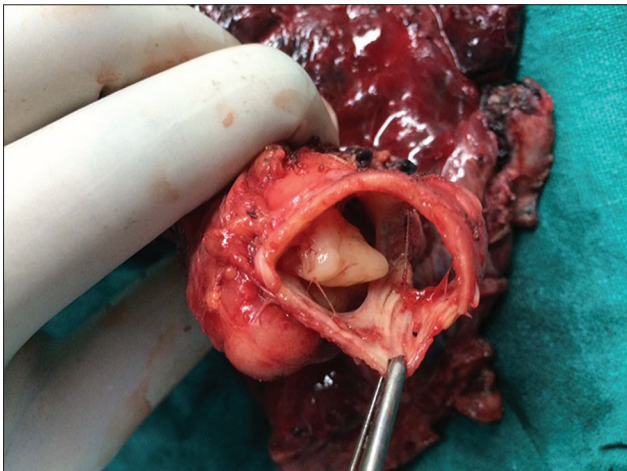


**Figure 2:** Case 2 (a) Axial CT section of chest shows the mass (white arrow) at the origin of the left main bronchus with extra-luminal component (b) Minimal intensity projection reconstructed coronal image depicts the irregular mass (white arrow) which almost completely obstructs the left main bronchus causing destruction of left lung with multiple cavities (c) CT virtual bronchoscopy image reveals the irregular mass projecting in the left main bronchus

uneventful. Figure 3 displays the gross resected specimen which shows left endobronchial growth with extra-luminal component. Microscopic examination confirmed adenoid cystic carcinoma; all the margins were tumor-free.

## DISCUSSION

Though the surgical techniques of carinal resection have been long described, success of carinal resection has recently been improved in view of improved surgical and anesthetic techniques, and better peri-operative care. Right posterolateral thoracotomy provides excellent exposure of lower trachea and left bronchus for right carinal pneumonectomy. The situation is not so pleasant surgically on the left side where lower trachea and right bronchus are underneath the aortic arch; it becomes technically difficult to have adequate access for a sound anastomosis. Different surgical approaches described for left carinal pneumonectomy are left thoracotomy, bilateral thoracotomy, clamshell approach (bilateral transverse thoracotomy and transverse sternotomy), and median sternotomy; each approach has its own advantages and disadvantages.<sup>[1]</sup> Major limitation of left thoracotomy approach is limited exposure of lower trachea and right bronchus because of the presence of aortic arch; however, it can be used for limited disease involving carina. Bilateral thoracotomy approach involves right thoracotomy followed by left: Initially right thoracotomy is done for carinal resection and anastomosis of right bronchus with trachea, and then left thoracotomy is done for left pneumonectomy. Recently, with the advancements of minimal access thoracic surgery, completion of left pneumonectomy can also be completed using video-assisted thoracic surgery or robotic surgery.<sup>[2]</sup> Both thoracic cavities are approached simultaneously in Clamshell approach. Median sternotomy mandates the division of anterior and posterior pericardium; it gives excellent exposure of carina through aorto-caval space. Moreover, median sternotomy also avoids the problems associated with thoracotomy incisional discomfort.<sup>[3]</sup> The main limitation of median sternotomy is difficult pneumonectomy as the access to left thoracic cavity



**Figure 3:** Gross resected specimen (case 2) which shows left endobronchial growth with extra-luminal component

is limited. This problem gets compounded when left lung is adherent densely to parietal pleura. We utilized median sternotomy approach in both of our patients for better exposure of trachea-bronchial region in order to achieve R'0' resection with good margins, and for ease of anastomosis between right bronchus and trachea. In our second patient, left lung was stuck densely to the parietal pleura because of obstructive pneumonitis; In order to achieve good access to left thoracic cavity and to mobilize the left lung, we had to perform ipsilateral transverse anterior thoracotomy through 4<sup>th</sup> inter-costal space.

Intraoperative ventilation is a major concern during a carinal pneumonectomy. A number of techniques have been described to maintain ventilation intra-operatively: Either by intubating the remaining bronchus using the sterile endotracheal tube connected to long sterile tubing passed to the anesthesiologist (cross ventilation) or jet ventilation.<sup>[4]</sup> While the anastomosis is in progress, intermittent apnea can be used to place the sutures precisely. As the jet ventilation uses a small diameter tube, it facilitates in placing the sutures without the need for intermittent apnoea.<sup>[5]</sup> Cardio-pulmonary bypass (CPB), though a potential option, should be discouraged to be used as it is associated with high postoperative morbidity.<sup>[6-8]</sup> However, we needed to place our both patients on CPB: In our first case, as single lumen endo-tracheal tube could not be placed properly in the remaining short length right main bronchus, and jet ventilator was not available in the theater; in our second case, presence of large extra-luminal component of endobronchial growth necessitated CPB to achieve R'0' resection.

Various maneuvers have been described to lessen the tension at the anastomotic site; these include flexion at the neck, mobilization of anterior pre-tracheal plane, and mobilization of the hilum using inferior hilar release. Following the division of the inferior pulmonary ligament, a U-shaped incision is made in the pericardium beneath the hilum with intra-pericardial division of the raphe, extending between the inferior pulmonary vein and the inferior vena cava.<sup>[6]</sup> After the completion of the procedure, A heavy "guardian" stitch is placed between the chin and chest placed to keep the patients' head in a mild degree of cervical flexion; this avoids excessive tension in the early postoperative period.

Though short-term outcome are related to operative procedure, long-term outcomes would depend upon the biology of the tumor for which carinal resection was undertaken. Initial reports of carinal resection in 1980s and 90s reported postoperative mortality of 30-40% following carinal resection and reconstruction.<sup>[6]</sup> In their experience of 13 cases of left carinal pneumonectomy, Mitchell *et al.* reported a significant mortality (31%), overall morbidity (69%), and anastomotic morbidity associated with the procedure.<sup>[9]</sup> Presently, better patient selection, advancements in radiological imaging to plan the surgery, improved surgical and anesthetic management techniques, and better perioperative care has resulted in better

postoperative outcome following carinal pneumonectomy. In a recently reported experience of 13 cases of carinal pneumonectomy (12 right and 2 left), Weder *et al.* did not have any 30-days postoperative mortality.<sup>[4]</sup>

## CONCLUSIONS

In conclusion, carinal pneumonectomy is a surgically safe and feasible procedure in select group of patients with endobronchial tumors which infiltrate the carina; proper selection of the patients, good pre-surgical planning, meticulous adherence to the surgical principles, and effective co-ordination between surgeons and anesthetists results in successful operative outcome.

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