

Left sleeve pneumonectomy performed through a clamshell incision for carinal invasion lung cancer: Report of a case

Abstract

Surgery for lung cancer involving the carina has been a challenge due to surgical technique and airway management. A case that was successfully treated with left sleeve pneumonectomy performed through a clamshell incision (bilateral thoracotomy through a transverse sternotomy) for carinal invasion of primary lung cancer, is reported. Without a cardiopulmonary assist device, adequate ventilation and oxygenation were maintained across the operative field with a spinal tube. Tracheo-bronchial anastomosis was relatively easy to perform with the excellent surgical view. The patients' postoperative course was uneventful, and chest CT showed no complications at the anastomosis. The patient was discharged without oxygen support. There has been no evidence of recurrence during 6 months of follow-up.

A clamshell incision approach provided an excellent surgical view without changing the position of the patient during the operation and could be a useful procedure for carinal surgery, especially for left sleeve pneumonectomy.

Introduction

Despite an improvement in surgical, interventional, and anesthetic techniques in tracheal surgery¹, carinal resection and reconstruction are still a challenge for thoracic surgeons because of several different approaches, technical difficulties, and perioperative complications. Most procedures have been performed through a posterolateral thoracotomy or median thoracotomy with or without an anterolateral thoracotomy. However, to date, there are few reports of carinal surgery through a clamshell incision, with a bilateral thoracotomy through a transverse sternotomy approach, except for lung transplantations. Herein, a case of primary lung cancer that underwent left sleeve pneumonectomy through a clamshell thoracotomy approach is reported.

Case report

A 71-year-old man was found to have an abnormal chest X-ray shadow on a routine annual medical check-up. He was referred to our hospital for further evaluation for surgery. Chest enhanced computed tomography (CT) demonstrated the wall thickness lesion on the left main bronchus, leading to the carina (Fig. 1). Coronal view CT also showed the mass shadow on the bifurcation of left main bronchus (Fig. 2). Bronchoscopic findings revealed obstruction of the left main bronchus, and the membranous portion of the carina going to the right main bronchus was slightly reddish (Fig. 3). A histological diagnosis of squamous cell carcinoma was made from examination of a biopsy specimen. No hilar or mediastinal lymph node swelling was seen. No distant metastases were seen on routine brain MRI and FDG-PET/CT scan. However, since the tumor was invading the second carina of the left lung, left sleeve

pneumonectomy was planned for curative resection. Clinical T4N0M0 stage IIIA disease was diagnosed. Physical examination revealed that the patient was in good general health, and performance status was 0. Pulmonary function tests showed that the vital capacity, percent of vital capacity, forced expiratory volume/1 second, and forced expiratory volume 1.0% were 1800 ml, 59.0%, 1240 ml, and 70.1%, respectively. A pulmonary perfusion scintigram confirmed that the decreased respiratory function was due to the stenosis of the left main bronchus. In the unilateral pulmonary artery occlusion test, pulmonary artery pressure was within 25 mmHg. Thus, the patient could tolerate left sleeve pneumonectomy, and it was decided to undertake surgical treatment for his lung cancer after obtaining detailed informed consent.

Under general anesthesia, the chest was entered through a clamshell incision thoracotomy through the fourth intercostal space. The sternum was divided in an inverted V shape. In case a cardiopulmonary crisis was to occur, the femoral artery and vein were secured for percutaneous cardiopulmonary support. First, the left pulmonary artery (PA) and veins were secured with a good surgical view. The posterior pericardium was cut, following which the right main PA and aorta were also taped. Systemic lymph node dissection was performed in the upper mediastinum and subcarinal area. Then, each vessel was carefully transected by an endocutter. After two rings resection of the right main bronchus, the right main bronchus was intubated immediately across the operative field with a sterile cuffed spiral tube (Fig 4). Finally, three rings resection of the trachea was done, and the left lung was removed. After checking for good condition with one lung ventilation and that the stump was cancer-free on frozen section, the anastomosis between the trachea and right main bronchus was begun. At first, the membranous portion received an end-to-end anastomosis by simple interrupted 3-0 monofilament absorbable sutures, following which the cartilage portion was similarly anastomosed. Each suture was tied outside the airway. This procedure was done during

intermittent periods of apnea, and then the original endotracheal tube was inserted beyond the anastomotic site after about two-thirds completion of anastomosis. After confirmation of air tightness at the anastomotic site, a thymic fat pad was used to cover the anastomosis. Right hilar release and separation of right pulmonary ligament was not performed. The sternum was fixed with three sternal wires (0.8 mm, Matsuda, Tokyo, Japan).

The operation time was 457 minutes, and the total amount of bleeding was 580 ml. Histopathology confirmed a moderately differentiated squamous cell carcinoma. Tumor involvement of the left main bronchus was also pathologically confirmed. Thus, patient was diagnosed with T4N0M0 stage IIIA disease. A follow-up chest CT showed no complications at the anastomosis site (Fig. 5). The patient was discharged on the 28th postoperative day without any oxygen support. He has a good quality of life with no evidence of recurrence after 6 months of follow-up.

Discussion

This is a report of carinal invasion lung cancer that was successfully resected through a clamshell incision, with a bilateral thoracotomy through a transverse sternotomy. This report highlights that a clamshell incision provided an excellent surgical view and a safe, secure anastomosis between the right main bronchus and the trachea.

Lung cancer involving the carina or the trachea-bronchial angle has been a challenge due to surgical technique and airway management. Recently, with careful patient selection, improvements in surgical and anesthesia techniques and postoperative management have enabled the resection of locally advanced lung cancers. The postoperative mortality for sleeve pneumonectomy has been reported to range from 6.1% to 7.5%, and the overall 5-year survival rate ranges from 26.5% to 33.4%.²⁻⁴

These results seem to be acceptable compared to those of standard pneumonectomy. However, long-term survival is mainly affected by nodal status, with N0-N1 patients having a significant advantage compared with N2-positive patients. Many reports have recommended that patients with N2 disease resistant to preoperative chemotherapy and/or radiotherapy should be excluded from this procedure.²⁻⁵

Moreover, left sleeve pneumonectomy is rarely indicated, since the left main bronchus is considerably longer than the right one, and, in the case of carinal involvement, the tumor usually involves the structures in the subaortic space as well, which automatically implies inoperability.⁵ Rea et al² reported that just one left pneumonectomy was done among 49 patients who underwent carinal resection. Thus, cure can be achieved for localized disease only. Moreover, once the resection is planned, the procedure itself is complicated. Surgical approaches including left posterolateral thoracotomy, bilateral anterolateral thoracotomy, and median sternotomy with or without left anterolateral thoracotomy have been used. Recently, a video-assisted thoracic surgery approach was also reported.⁶

Thus, controversy still exists regarding the best surgical approaches for left sleeve pneumonectomy. However, the success of any approach depends on several principles: optimal surgical view, avoidance of anastomotic tension, preservation of airway vascular supply, and adequate ventilation and oxygenation.⁷ A clamshell incision has been widely performed, especially in lung transplantations, for its excellent surgical view and the need for cardiopulmonary bypass. We thought that this procedure could satisfy all of the above principles for the following reasons.

First, complete resection was absolutely necessary for a negative surgical margin. In the case of a positive surgical margin, additional tracheal or bronchial resection was needed. A clamshell incision could easily resolve this problem. Second, for releasing tension we performed two maneuvers, one was subcarinal lymph node dissection, and

the other was only 3 rings circumferential dissection of the lower trachea, which was necessary for anastomosis to preserve as much blood supply as possible. In contrast to median sternotomy, right inferior hilar release can be easily done with this procedure. In this case, we did not need to perform this procedure because of confirmation of tension-free anastomosis. Third, with the clamshell incision, the position of the patient did not need to be changed during the operation.

Thus clamshell incision should be recommended in case that left sleeve pneumonectomy has planned, moreover, tension free maneuvers (i.e. right hilar release and separation of right pulmonary ligament) and cardiopulmonary support has expected.

Adequate one-lung ventilation and oxygenation were maintained across the operative field with a sterile cuffed spiral tube. We fortunately did not need to use a cardiopulmonary assist device, which allows the advantage of hemodynamic stability, easier access, and simplified reconstruction.⁸ Despite the fact that there is a significant risk for bleeding complications due to the need for heparinization, and spilling of tumor cells could potentially occur during suction of blood into the cardiopulmonary bypass reservoir⁵, we should be prepared for emergent cardiopulmonary decompression.

Anastomotic dehiscence for carinal surgery is sometimes fatal.⁹ Empyema, localized necrosis, and stenosis of the anastomotic site is sometimes seen. No anastomotic complications were seen in the present case. This implied that we could reconstruct the airway successfully while preserving a good blood supply, a tension-free, accurate anastomosis, and covering with a thymus fat pad with this procedure.

However, we recognize that this clamshell incision has some disadvantages, since its larger skin incision compared to other procedures needs more intercostal muscle dissection, resulting in the loss of respiratory function recovery and causing more postoperative pain. Furthermore, sternal malunion can be a significant cause of

morbidity with this procedure.¹⁰

In conclusion, we believe that bilateral thoracotomy through a transverse sternotomy, a clamshell incision approach, provides an excellent surgical view, and could be one of the surgical procedures used for carinal surgery, especially for left sleeve pneumonectomy.

Disclosures and Freedom of Investigation

We have no personal conflict of interest and no outside support for this research.

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Figure legends



Figure 1. Chest enhanced CT shows the wall thickness of the left main bronchus, leading to the carina.

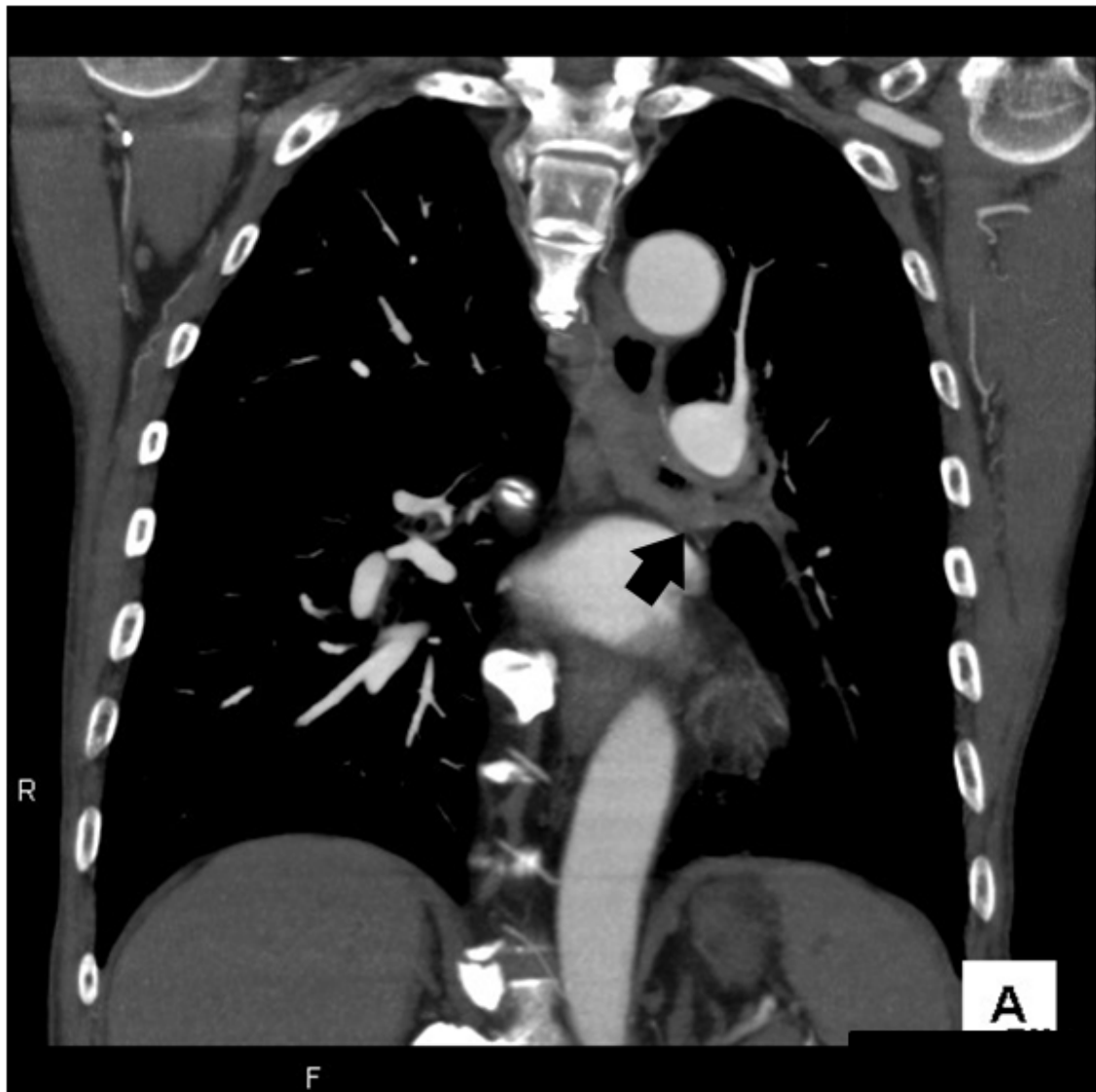


Figure 2. Coronal view of chest enhanced CT also showed the mass shadow on the second carina (arrow).

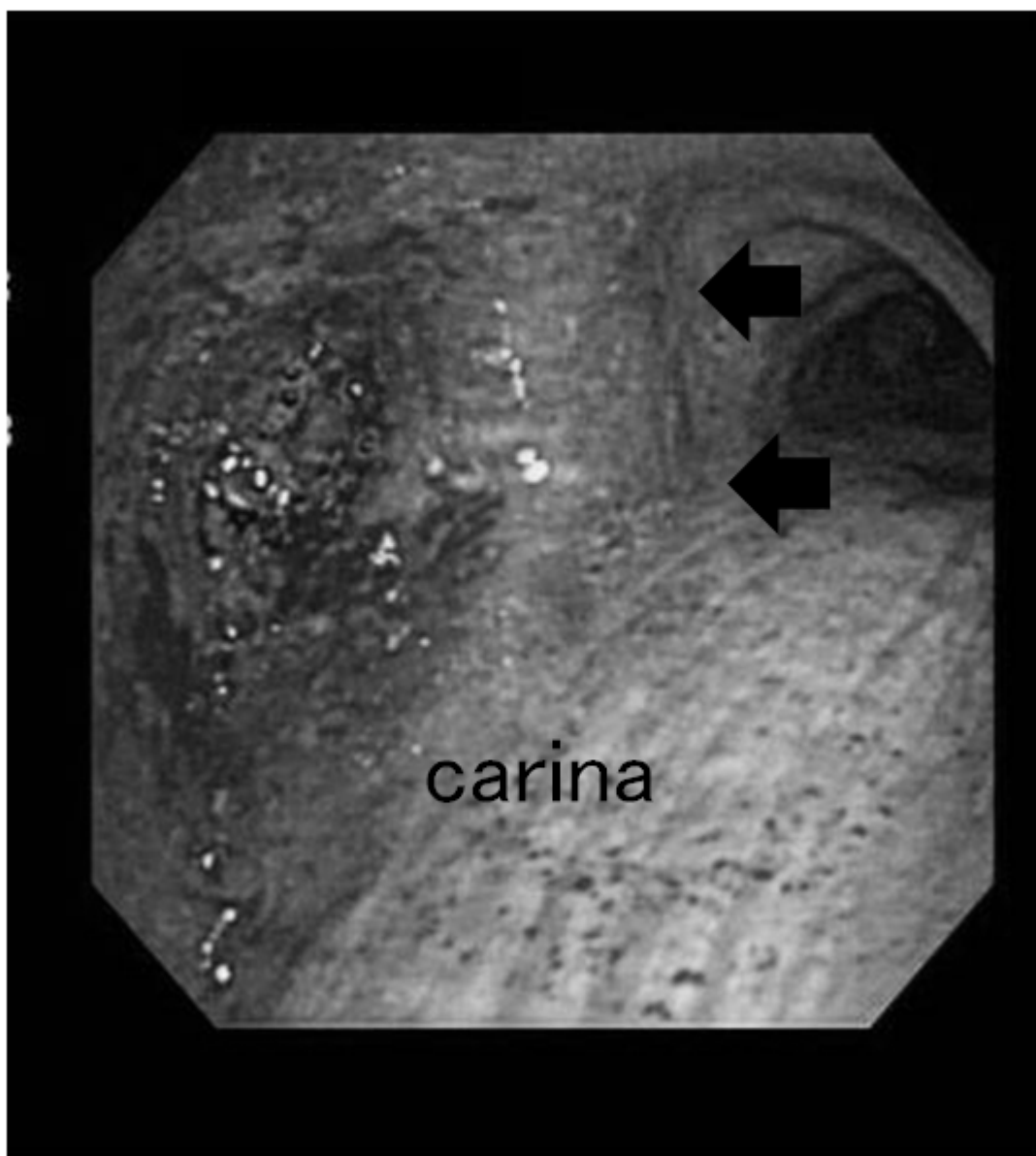


Figure 3. Bronchoscopic findings reveal a tumor invading from the left main bronchus to the carina, as well as the right main bronchus (arrow).

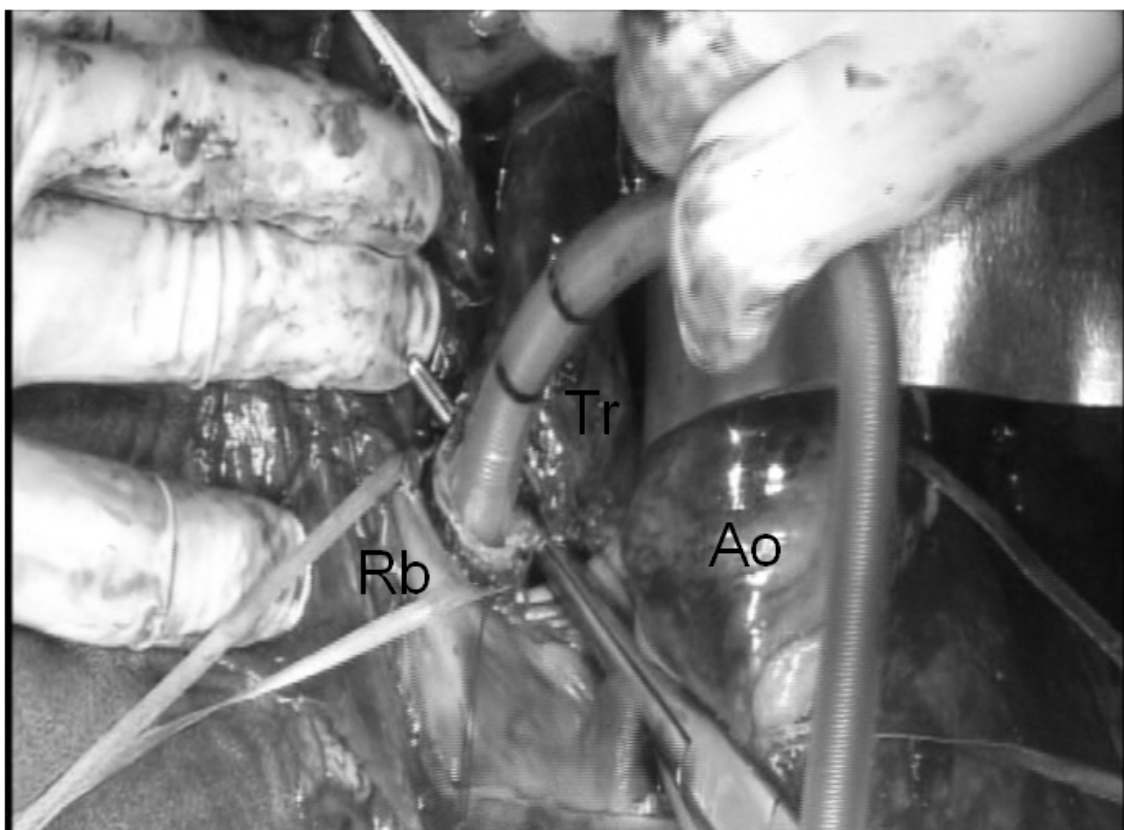


Figure 4. An excellent surgical view can be seen through the clamshell thoracotomy. Carinal reconstruction was successfully performed without any cardiopulmonary support. Ao = aorta, Rb = right main bronchus, Tr = trachea



Figure 5. Post-operative chest CT (coronal view) shows no stenosis at the anastomotic site.