


# Left upper lobectomy with combined distal aortic arch and left subclavian artery resection after neoadjuvant chemoradiotherapy for locally advanced lung squamous cell carcinoma

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## Abstract

T4 locally advanced non-small cell lung cancer (NSCLC) is a heterogeneous group with a great variety of involved organs and is associated with a poor prognosis. However, appropriately selected patients benefit from surgical resection. The surgical indication must be carefully considered based on the risk–benefit between high surgical stress and expected prognosis, particularly in cases with probable aortic involvement. Here, we report a long-term survival case of left upper lobe squamous cell carcinoma, in which lobectomy and combined distal aortic arch and left subclavian artery resection achieved a complete resection after induction chemoradiotherapy (CRT). Appropriate patient selection considering expected prognosis, induction CRT and complete resection under well-planned cardiopulmonary bypass are essential to achieve a long-term survival on T4 NSCLC with a probable aortic involvement

## KEYWORDS

chemoradiotherapy, combined aorta resection, locally advanced lung cancer, selective cerebral circulation

## INTRODUCTION

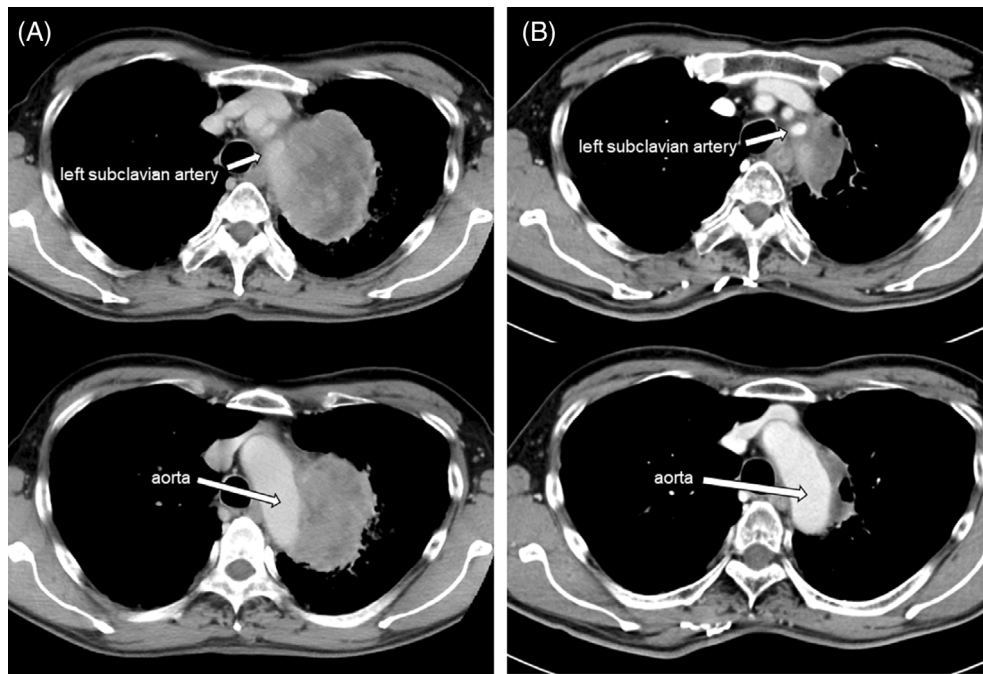
T4 locally advanced non-small cell lung cancer (NSCLC) is a heterogeneous group involving a variety of organs, including the great vessels and other mediastinal structures.<sup>1</sup> Although generally associated with poor prognosis, appropriately selected patients with T4N0-1M0 benefit from surgical resection.<sup>1–3</sup> Surgical indications must be carefully considered based on the risk–benefit between high surgical stress and expected prognosis in probable great vessel invasion during pre-operative investigations. Here, we report a long-term survival case of lung squamous cell carcinoma (SCC), in which lobectomy and combined distal aortic arch and left subclavian artery resection achieved a complete resection after induction chemoradiotherapy (CRT).

## CASE REPORT

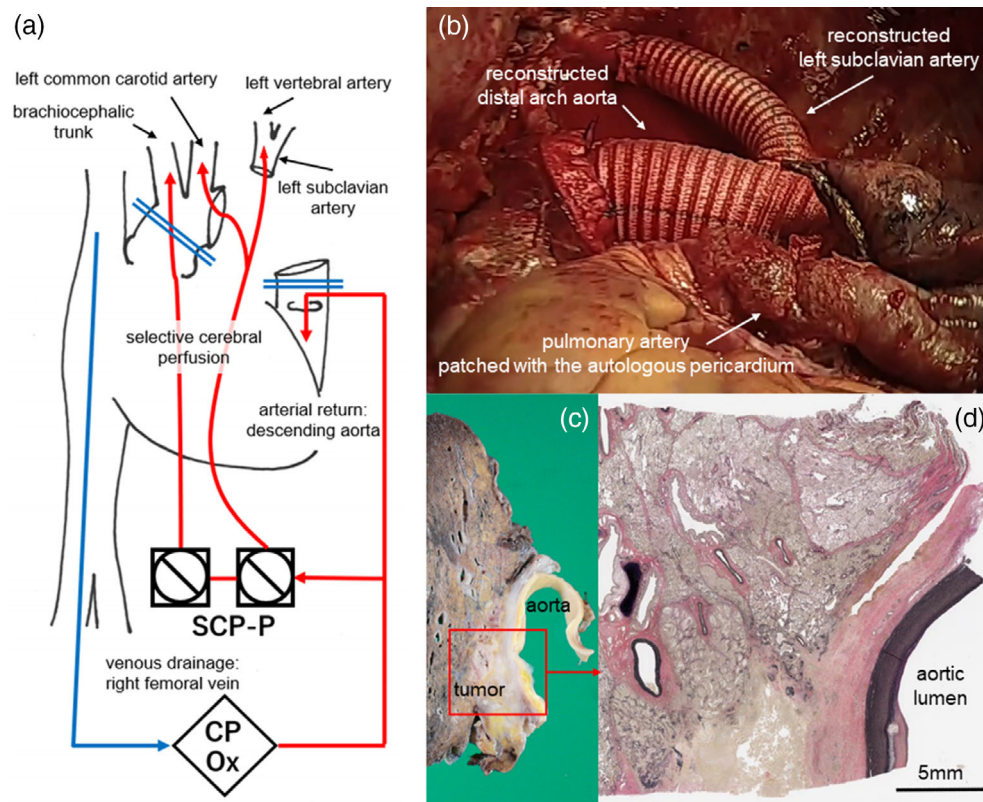
A 61-year-old male patient, a current smoker with an 86-pack-year smoking history, presented with a left upper lung field mass shadow on a chest x-ray. Chest computed tomography (CT) revealed a mass of 8 cm in diameter in the left upper lobe with a probable distal aortic arch and left subclavian artery invasion (Figure 1A). An enlarged sub-aortic lymph node (24 × 12 mm) was detected, without any other locoregional lymphadenopathy. A trans-bronchial biopsy demonstrated SCC. Radiological workups, including positron emission tomography and brain magnetic resonance imaging (MRI), were negative for distant metastasis. Endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA) showed no evidence of metastasis in the subaortic lymph node. Thus, the patient was clinically diagnosed with

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**FIGURE 1** Chest computed tomography demonstrated a tumour in the left upper lobe with the left subclavian artery (upper panel) and distal aortic arch (lower panel) involvement (A). The tumour decreased in size after two cycles of tri-weekly cisplatin and docetaxel with concurrent radiation therapy (46 Gy) (B).



**FIGURE 2** We established cardiopulmonary bypass by cannulation of the descending aorta for arterial return and the right femoral vein for venous drainage. The aorta was transected proximal to the left subclavian artery. Selective cerebral perfusion was conducted by cannulation of the brachiocephalic trunk, the left common carotid and the left vertebral arteries (A). The resected distal aortic arch and the left subclavian artery were reconstructed with a 26-mm two-branched Dacron graft. The pulmonary artery trunk defect resulting from resection of A3, A4 + 5 and A1 + 2 tumour involvement was reconstructed with an autologous pericardium patch (B). The gross appearance of the surgical specimen showed aortic involvement (C). Histopathological examination demonstrated mediastinal fat invasion. No viable cancer cells remained in the involved aortic wall with fibrosis on Elastic van Gieson staining ( $\times 100$  magnification) (D)

stage IIIA (cT4N0M0), prompting induction CRT followed by radical surgery. The patient was initially treated with two cycles of tri-weekly cisplatin and docetaxel with concurrent radiation therapy (46 Gy). Re-staging CT revealed decreased tumour size (Figure 1B), without pleural dissemination or distal metastasis. Additionally, brain MRI demonstrated no brain metastasis. The induction CRT had partial treatment response; however, the stage after the initial treatment was ycT4N0M0 stage IIIA, without downstaging due to great blood vessel invasion. The Eastern Cooperative Oncology Group performance status of the patient was 0. Spirometry tests revealed a vital capacity of 4.03 L (93.2% predicted) and a forced expiratory volume in 1 s of 2.87 L (71.6% predicted), supporting surgical tolerance for left upper lobectomy. We scheduled a left upper lobectomy with combined distal aortic arch and left subclavian artery resection under selective cerebral perfusion and hypothermic circulatory arrest because radical cure was expected by further local control.

The surgery was initiated with posterolateral thoracotomy in the right semi-lateral position. The superior pulmonary vein and the upper lobe bronchus were dissected. We encircled a left main pulmonary artery root because the tumour involved anterior (A3), lingular (A4 + 5) and apicoposterior (A1 + 2) pulmonary artery origins. Additionally, the tumour involved the distal aortic arch and the left subclavian artery. A cardiopulmonary bypass was established by descending aorta and right femoral vein cannulation for arterial return and venous drainage, respectively. After hypothermic circulatory arrest and haemostasis, the aorta was transected proximal to the left subclavian artery, followed by selective cerebral perfusion and brachiocephalic trunk, left common carotid and left vertebral artery cannulation (Figure 2A). Combined distal aortic arch and left subclavian artery resection was completed by transecting the descending aorta distal to the tumour. Subsequently, the left upper lobe en bloc resection was accomplished by resecting A3, A4 + 5 and A1 + 2, including the pulmonary artery trunk wall. The upper and lower mediastinal lymph nodes were dissected. The distal aortic arch and the left subclavian artery were reconstructed using a 26-mm two-branched Dacron graft (JNW-261109K, Japan Lifeline, Tokyo, Japan). The pulmonary artery trunk defect was reconstructed with an autologous pericardium patch (Figure 2B). The total operation time was 11 h with a blood loss of 966 ml that required red blood cell and fresh-frozen plasma transfusions at 280 and 1440 ml, respectively.

The patient was extubated on the first postoperative day, with anticoagulation for persistent atrial fibrillation. Although postoperative pleurisy with exudative pleural effusion required treatment with re-drainage and antibiotics, he was discharged on the 22nd postoperative day. Histopathological examination demonstrated residual SCC that invades the mediastinal fat tissue. No viable cancer cells remained in the involved aortic wall with fibrosis (Figure 2C,D). The hilar lymph nodes were positive for metastasis confirming stage IIIA (ypT4N1M0); however, we curtailed adjuvant

chemotherapy due to the patient's deteriorated performance status. The patient is alive without disease recurrence 7 years after the surgery.

## DISCUSSION

In our case, surgical indications were decided by considering the complete resection feasibility and expected prognosis after the complete resection.

Complete resection is an absolute prognostic factor for NSCLC. Induction CRT is frequently performed for eradicating micro-metastasis and downsizing large tumours for advanced diseases. Here, preoperative radiological workup after induction CRT revealed no evidence of distal metastasis or pleural dissemination. Additionally, we conducted a combined distal aortic arch and left subclavian artery resection under hypothermic circulatory arrest, followed by selective cerebral circulation, all enabling en bloc complete resection to assure curability.

Lobectomy after concurrent induction CRT improves the progression-free survival (hazard ratio: 0.77).<sup>4</sup> Patients with T4 NSCLC, aged <70 years, without lymph node metastasis (N0), are reported with a good prognosis (5-year survival rate: 50.3%).<sup>1</sup> Our patient was young (61 years old). The preoperative staging based on radiological workup and EUS-FNA demonstrated no evidence of lymph node metastasis; thus, cT4N0M0 was assumed, prompting surgical indication. The hilar lymph node metastasis (N1) was histopathologically demonstrated after the surgery; however, a 7-year survival without disease recurrence was achieved. The use of well-planned cardiopulmonary bypass is reportedly crucial for favourable long-term survival, like in our case.<sup>5</sup>

In conclusion, we experienced a complete resection case of locally advanced lung SCC with distal aortic arch involvement after neoadjuvant CRT. Surgical indications based on complete resection feasibility and prognostic factors may have contributed to long-term survival.

## AUTHOR CONTRIBUTION

Yusuke Takanashi drafted the manuscript. Kazuhito Funai, Akikazu Kawase and Keigo Sekihara collected clinical data, commented on and revised the manuscript. Daisuke Takahashi, Yuta Matsubayashi, Takamitsu Hayakawa, Katsushi Yamashita and Norihiko Shiiya commented and critically revised the drafted manuscript. All authors approved the final manuscript.

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## CONFLICT OF INTEREST

None declared.

## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## ETHICS STATEMENT

The authors declare that appropriate written informed consent was obtained for the publication of this manuscript and accompanying images.

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