Case Report

Bilateral Trans-Septal Approach to Right Lung Cancer Invading the Left Atrium

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We describe a 69-year-old woman with primary lung cancer in the right lower lobe invasive to the left atrium (LA) via the pulmonary vein (PV). The tumor in the LA measured 30 × 26 mm, and to avoid critical embolism preoperative induction therapy was not performed. The patient underwent right thoracotomy under cardiopulmonary bypass (CPB), and the atrial septum was incised via the right atrium. The tumor was placed out of the LA, followed by lobectomy. For right lung tumors invading the LA, the bilateral trans-septal approach is useful for confirming the surgical margin.

Keywords: lung cancer, pulmonary vein, left atrial resection, cardiopulmonary bypass, bilateral trans-septal approach

Introduction

Among cases of T4 lung cancer, many facilities now consider that surgical treatment is indicated for tumors that have invaded the left atrium (LA).1) We recently encountered a case of advanced primary lung cancer invading the LA through the right pulmonary vein (PV). Here, we report a surgical approach for resection of this tumor along with right middle-lower lobectomy via a biatrial trans-septal approach under cardiopulmonary bypass (CPB).

Case Report

A 69-year-old woman presented at our hospital because of bloody sputum. She was otherwise asymptomatic and a physical examination revealed no abnormalities. Laboratory findings were unremarkable, with no signs of inflammation. Chest X-ray demonstrated a mass measuring 49 × 45 mm in the right hilum (Fig. 1A), and computed tomography (CT) findings suggested a primary lung cancer in the right lower lobe that had invaded the LA via the PV (Fig. 1B). The tumor in the LA measured 30 × 26 mm and showed uptake on 18F fluorodeoxyglucose positron emission tomography (FDG-PET) (Fig. 1C). Measurement of tumor markers demonstrated a carcinoembryonic antigen (CEA) level of 91.8 ng/mL (cutoff, <5 ng/mL) and a pro-gastrin-releasing peptide (proGRP) level of 203.0 pg/mL (cutoff, <74.7 pg/mL). Brain magnetic resonance imaging (MRI) showed no distant metastases, and a diagnosis of adenocarcinoma was obtained by bronchoscopic cytology. On the basis of these results, the adenocarcinoma was staged as T4N1M0, stage IIB, and complete resection of the tumor under CPB was considered possible. To avoid the possibility of critical embolism from the polypoid tumor, the patient did not receive preoperative induction therapy. Transesophageal echocardiography (TEE) visualized the tumor protruding
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from the PV, but was unable to demonstrate whether the tumor had invaded the LA wall adjacent to the PV.

Surgery was performed via a 4th intercostal thoracotomy with an antero-axillary line incision under general anesthesia, and cannulation for CPB was carried out including a double vena cava for blood removal as well as the ascending aorta for delivery; cardiac arrest was obtained by antegrade cardioplegic infusion (Fig. 2). Via an atrial septum incision from the right atrium, the tumor protruding from the PV was directly confirmed (Fig. 3A) and no apparent invasion of the left atrial wall was recognized. The tumor was placed out of the LA through the incision around the origin of the PV inside the pericardium (Fig. 3B), and resected along with the PV. After resection, the stump of the LA, the atrial septum, and the right atrium were double sutured using 4-0 polypropylene. The aortic cross-clamping time was 65 minutes and the CPB time was 104 minutes. Right lower lobectomy and complete mediastinal lymph node dissection were performed while weaning from CPB, but right middle lobectomy was subsequently performed because of a residual tumor in the bronchial stump. The postoperative course was uneventful without any noteworthy complications, and the patient was discharged home on the 20th postoperative day. The pathological specimen revealed small cell carcinoma combined with adenocarcinoma, pT4N2M0, stage III B. Four cycles of postoperative chemotherapy with carboplatin (CBDCA) and irinotecan (CPT-11) were performed. Brain metastases were recognized 10 months after surgery, for which whole brain irradiation was performed, and since then outpatient follow-up has been performed for 15 months.
Tumor invasion to the LA may occur as a result of direct invasion of a primary tumor or lymph node metastasis, or invasion of a contiguous tumor through the PV draining from the primary site. Although the latter type is less frequent, special attention must be paid to tumor emboli during surgery, especially when the tumor exhibits polypoid extrusion. Surgery for non-small-cell lung carcinoma (NSCLC) including LA resection usually involves vascular clamping, but when the tumor is growing in the LA, resection of the LA by clamping, and simple manipulation is considered inappropriate in terms of the completeness of resection and safety. In such cases, combined LA resection under CPB is advantageous because it allows combined resection of unresectable tumors involving the heart and great vessels, as well as yielding a better view of the surgical field. However, some disadvantages have been reported, such as hemorrhage, the possibility of hematogenous dissemination of the tumor cells, an increased risk of infection resulting from temporarily compromised cellular immunity, and high cost.

Although the use of chemotherapy is usually reserved for patients with N2 or chest wall involvement, the role of induction or neoadjuvant chemotherapy or chemoradiotherapy in T4-NSCLC patients remains unclear. Induction chemoradiotherapy is reported to be useful for management of locally advanced NSCLC invading the LA and may enable CPB to be avoided during surgery, and we could not find a report of tumor thrombus developed after induction therapy. However, tumor thrombus was reported in the cases with the tumor extended into the LA, and the fatal case was reported. We could not judge the fragility of the tumor by CT or TEE before the operation. But the tumor in the PV is more attenuate than the part in the LA and the tumor continued to be moved by the beating heart. Therefore, the tumor might be torn off or developing fragmentation by induction therapy. Therefore, we thought the cases with the tumor extended into the main PV or the LA should be performed surgery first, instead of performing surgery following induction therapy.

Before incision of the LA, confirmation of the extent of LA wall invasion is necessary. TEE is useful for confirming the tumor in the LA, but for large tumors it is unable to demonstrate the invaded LA wall, as was the case in our patient. Furthermore, it is difficult to assess the extent of invasion from outside the LA during surgery. Therefore, invasion of the LA wall must be confirmed from inside the LA. Here, we employed bilateral trans-septal approach and this yielded a good view in the LA without the need for LA incision. From the RA through the atrial septum, the tumor in the LA was observed directly, and we were able to confirm that there was no invasion to the LA wall around the PV. This approach was first described by Dubost et al., and has since been used for mitral valve surgery and resection of myxoma in patients who require right-sided procedures.
or those who have a small LA, have undergone previous mitral valve operations, or have a high body mass index. Here, we performed lobectomy via a right thoracotomy and resected the tumor in the LA under CPB without additional thoracotomy.

**Conclusion**

For cases of right lung tumor invading the LA through the PV, lobectomy via a right thoracotomy and a bilateral trans-septal approach under CPB is useful for confirming atrial wall invasion by direct observation from the right atrium.

**Disclosure Statement**

All authors, and our spouses or other immediate family, have no financial relationship with a biotechnology manufacturer, a pharmaceutical company, or other commercial entity that has an interest in the subject matter or materials discussed in the manuscript.

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