

## Video-Assisted Thoracoscopic Surgery for Non-Small Cell Lung Cancer in Patients on Hemodialysis

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**There have been a few reports of pulmonary resection for lung cancer in patients on hemodialysis (HD), but no reports of video-assisted thoracoscopic surgery (VATS) in these patients have been submitted. We describe two patients on HD undergoing thoracoscopic resection for lung cancer. For the thoracoscopic operation, anatomies of the patients were confirmed by three-dimensional multidetector computed tomography (3D-MDCT). The first patient underwent a right lower lobectomy thoracoscopically, and the second patient underwent a resection of the superior segment of the right lower lobe thoracoscopically. They were discharged on postoperative days 10 and 4, respectively. A review of the literature reveals that morbidity and mortality for pulmonary resection on HD are 74% and 11%, respectively. Thoracoscopic operations for lung cancer patients on HD may minimize the operative invasiveness. Preoperative 3D-MDCT angiography was useful because it supports understanding of the patient's personal anatomy for VATS. (Ann Thorac Cardiovasc Surg 2010; 16: 40–44)**

**Key words:** hemodialysis, non-small cell lung cancer, video-assisted thoracoscopic surgery, three-dimensional computed tomography

### Introduction

In the normal population, the relative risk of lung cancer in patients undergoing hemodialysis (HD) seems to be no higher than 0.8.<sup>1)</sup> Because the percentage of patients on HD has increased, the number of surgical resections for lung cancer is expected also to rise.<sup>2)</sup> Despite this trend, only two series of seven pulmonary resections performed in patients on HD have been reported until now.<sup>2–4)</sup> A PubMed search of HD and lung resection showed only

four other case reports from Japan.<sup>5–8)</sup> Furthermore, no thoracoscopic operations of lung resection in HD patients have been reported.

Patients on HD undergoing surgery represent a high-risk group requiring careful perioperative management to avoid electrolyte imbalance and hemodynamic instability.<sup>2)</sup> Because of the increased risk of operative complications, patients on HD are often not considered suitable for thoracic surgery procedures.<sup>3)</sup> Few reports focus on the management of major surgical procedures and outcomes of such patients on maintenance HD.<sup>9)</sup>

We report on two patients on HD with non-small cell lung cancer (NSCLC) because of chronic renal failure; they underwent lobectomy or segmentectomy under video-assisted thoracoscopic surgery (VATS). For the thoracoscopic operations, personal anatomies of the patients were preoperatively confirmed by three-dimensional multidetector computed tomography (3D-MDCT) angiography.

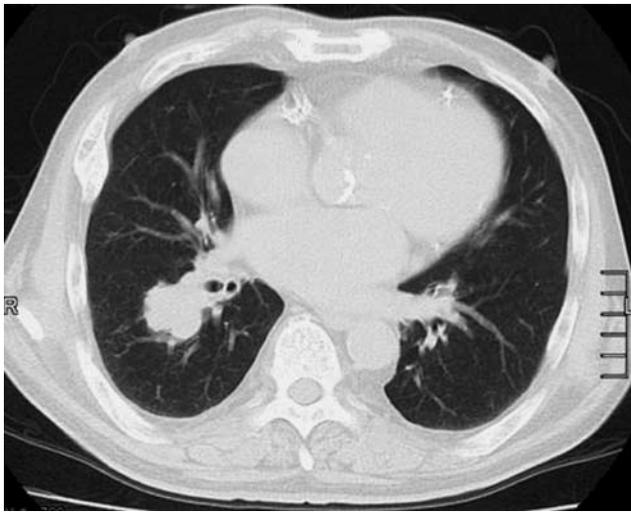
Further, we provide a review of the existing literature

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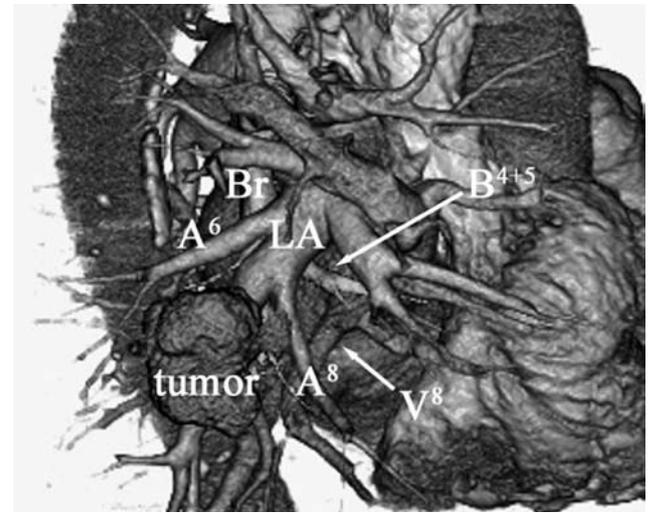
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**Fig. 1.** Case 1.

Computed tomography showing an irregular tumor in the right basal segments of the right lower lobe. Radiological findings are consistent with the diagnosis of primary lung cancer. We observed a deformity of the right rib resulting from an old chest injury.



**Fig. 2.** Case 1.

Three-dimensional multidetector computed tomography showing the tumor, an anomalous pulmonary vein ( $V^8$ ) draining to the superior pulmonary vein, the lower-lobe artery (LA), its branches ( $A^6$ ,  $A^8$ ), bronchus (Br), and middle-lobe bronchus ( $B^{4+5}$ ).

about surgeries conducted in patients on HD and their outcomes.

## Patients and Methods

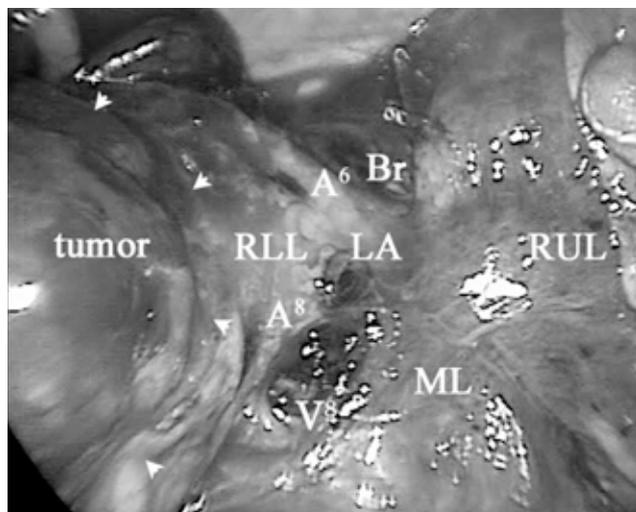
The patients were scheduled for operations the day after routine HDs, and volume overhydration was avoided during operation. They received VATS under anesthesia with remifentanyl and propofol. To prevent or to detect early any perioperative complications in dialyzed patients, such as metabolic problems (hyperkalemia and acidosis), pulmonary problems (sputum retention, pneumonia, pulmonary edema, and respiratory insufficiency), and hemodynamic instability (heart failure), the patients received preoperative respiratory rehabilitation and began early ambulation. They also received postoperative measurements of vital signs, blood counts, laboratory examinations of blood, and examinations of chest roentgenograms.

For the VATS procedures, a minithoracotomy incision of approximately 2 cm was made in the 4th intercostal space on the anterior axillary line as an access port. Four other stab wounds of approximately 2 cm each were made. The thoracoscope had a 10 mm diameter and a 30° lens. Most vascular structures were dissected using Endo staplers with staple dimensions of 2.0 to 2.5 mm, and the lobar bronchus and interlober fissures were divided using Endo staplers with dimensions of 3.8 to 4.1 mm. After the

wounds were extended to 4–5 cm without a rib retractor, the operative specimens were carefully removed from the wound on the anterior 4th intercostal space.

## Case 1

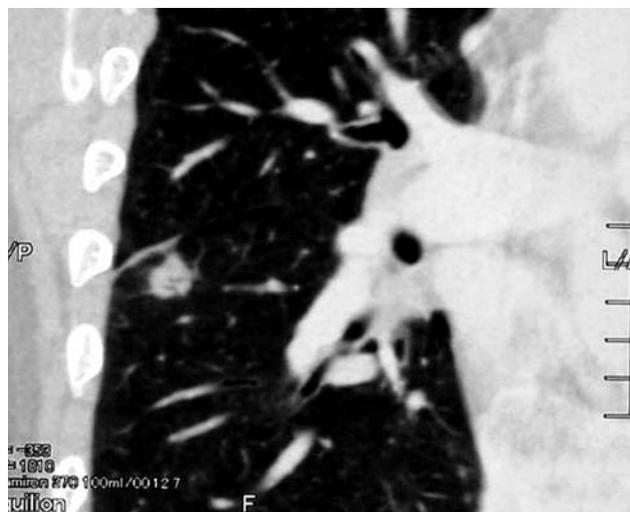
A 65-year-old man was detected with an abnormal shadow on the chest CT and was referred to our department for further evaluation (Fig. 1). The chest 3D-MDCT revealed that the abnormal shadow in the right lower lobe measured 31 × 26 mm and was radiologically diagnosed as primary lung cancer, cT2N0M0, stage 1B (Fig. 2). It was growing compared to the chest CT 6 months before, and the elevation of serum carcinoembryonic antigen (CEA) level was observed at 15.8 ng/ml. He had complications from diabetic chronic renal failure and had been undergoing HD for 9 years. The patient's blood urea nitrogen and serum creatinine levels were elevated to 58 and 10.3 mg/dl, respectively. Our treatment plan was to operate without the lung biopsy. Preoperative  $PO_2$  and forced expiratory volume in 1 second (FEV 1.0) were 89.0 mmHg and 2.10 l, respectively. The need for percutaneous coronary intervention (PCI) was determined from his preoperative heart evaluation. The patient underwent a thoracoscopic right lower lobectomy and hilar lymph-node dissection 1 month after PCI (Fig. 3). The operative course was uneventful, and the operation time and amount of bleeding



**Fig. 3.** Case 1.

Thoracoscopic view. The lower-lobe artery (LA), its branches (A<sup>6</sup>, A<sup>8</sup>), and the bronchus (Br) were separated, and the LA is about to be divided by use of an endoscopic staple.

Arrowhead, tumor; RUL, right lower lobe; ML, middle lobe; RLL, right lower lobe; V<sup>8</sup>, an anomalous pulmonary vein.



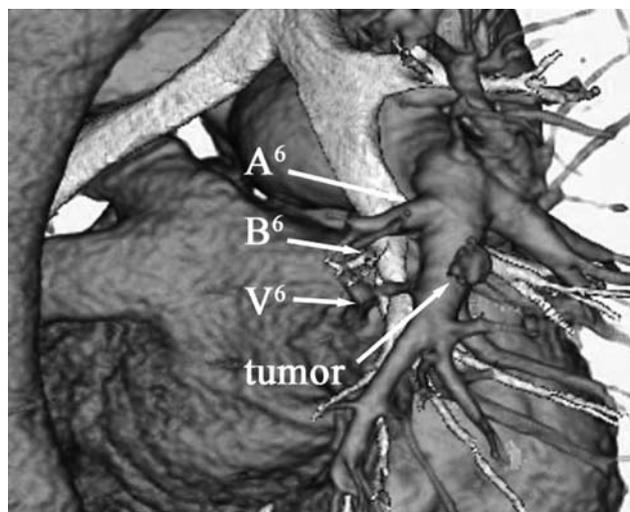
**Fig. 4.** Case 2.

Computed tomography showing a consolidation in the superior segment of the right lower lobe (S<sup>6</sup>).

were 225 min and 150 ml. The pathological diagnosis was adenocarcinoma of the lung without lymph-node metastases, and the tumor-node metastases (TNM) classification and clinical stage were pT2N0M0 and stage 1B, respectively. Postoperative acidosis (pH 7.272) was observed, and the patient underwent chronic HD on the operative day using nafamostat mesilate instead of heparin to avoid bleeding. He was discharged on postoperative day 10 and showed no evidence of lymph-node or distant metastases 10 months after the operation.

## Case 2

A 46-year-old man was found to have an abnormal shadow on his chest CT while in the hospital for induction of HD. He was referred to our department for further evaluation. The CT showed a consolidation measuring 12 × 12 mm in the superior segment of the right lower lobe (S<sup>6</sup>) (Figs. 4 and 5), and the chest CT 2 years before had also revealed a consolidation in the same region; it measured 5 × 5 mm. The patient was radiologically diagnosed with primary lung cancer, cT1N0M0, stage 1A. After the HD induction, an operation was scheduled without pathological diagnosis. The patient's preoperative blood urea nitrogen and serum creatinine levels were 45 and 10.0 mg/dl, respectively. Preoperative PO<sub>2</sub> and FEV 1.0 were 86.6 mmHg and 3.08 l, respectively. The patient under-



**Fig. 5.** Case 2.

Three-dimensional multidetector computed tomography showing the tumor, the superior segment of the lower lobe artery (A<sup>6</sup>), the bronchus (B<sup>6</sup>), and the vein (V<sup>6</sup>).

went thoracoscopic segmentectomy (S<sup>6</sup>). The operative course was uneventful, and the operation time and amount of bleeding were 185 min and 300 ml, and the pathological diagnosis was adenocarcinoma of the lung, stage 1A. The postoperative course was uneventful, and the patient was discharged on postoperative day 4. No recurrence was observed 14 months after the surgery.

**Table 1. Reports of the pulmonary resections for NSCLC in patients on hemodialysis**

		Number of patients	Operative procedure		Morbidity	Total	Mortality
2005	Ciriaco et al. <sup>2)</sup>	6	Pneumonectomy	1	Hyperkalemia	2	0
			Lobectomy	5	Atrial fibrillation		
			Wedge resection	1	&sputum retention	2	
2001	Tsuchida et al. <sup>4)</sup>	7	Lobectomy	7	Lung edema, pneumonia	1	Pneumonia 1
					Sputum retention	2	Cerebral bleeding 1
					Hyperkalemia	4	
					Atrial fibrillation	1	
1992	Ohta et al. <sup>5)</sup>	1	Pneumonectomy	1	Hyperkalemia	1	0
1996	Yamamoto et al. <sup>6)</sup>	1	Lobectomy	1	Heart failure and hyperkalemia	1	0
1999	Naito et al. <sup>7)</sup>	1*	Wedge resection	1		0	0
2005	Yajima et al. <sup>8)</sup>	1	Lobectomy	1	Respiratory failure	1	0
Present case	Akiba et al.	2	Lobectomy	1	Hyperkalemia	1	0
			Wedge resection	1			
Total		19		20		15	2

\*, thyroid cancer.

## Discussion

There have been only a few reports of pulmonary resection for NSCLC and perioperative problems in patients on HD (Table 1). Ciriaco et al. reported six patients on HD who underwent seven pulmonary resections.<sup>2)</sup> Five patients underwent lobectomy, 1 a wedge resection and 1 a pneumonectomy. No operative mortality was reported, and postoperative atrial fibrillation associated with sputum retention occurred in 2 patients; another 2 had hyperkalemia (complication rate 57%). Tsuchida et al. reported 7 patients on HD undergoing standard lobectomy with lymph-node dissection for lung cancer.<sup>4)</sup> There was one operation-related death resulting from pulmonary edema and a subsequent development of pneumonia. All the other six patients also had complicated sputum retention, hyperkalemia, or atrial fibrillation. One patient died of cerebral bleeding that occurred during dialysis 2 months postoperatively. A wide variety of metabolic and hemodynamic changes occur in chronically dialyzed patients, leading to an enhanced susceptibility to postoperative complications, such as pulmonary infections, hyperkalemia, hemodynamic instability, and a tendency to bleed.<sup>4)</sup> According to four other case reports on HD, 1 partial resection, 2 lobectomies, and 1 pneumonectomy were performed, and 3 patients among 4 had complicated heart failure, respiratory insufficiency, or hyperkalemia.<sup>5–8)</sup> From the above 6 reports and our cases, morbidity and mortality rates of pulmonary resection on HD were estimated at 75% and 10%, respectively.

As for case 1, mediastinal lymph node dissection was not performed because of the high risk. As for case 2, we intended radical segmentectomy according to the report of Okada et al. because the size of the tumor was 1.2 cm (2 cm or less).<sup>9)</sup>

Referring to other major operations conducted while patients were on HD, there was 0%–10% death related to elective gastrointestinal surgery, and only 6%–15% patients developing complications.<sup>10,11)</sup> In cases of emergency gastrointestinal surgery, complications occurred in 40%–70% and death in 24%–50%. Gastrointestinal elective surgery in patients on HD can be performed with relatively low morbidity and mortality rates. As for the duration of the HD, patients with a history of more than 2 years had a significantly higher mortality rate following abdominal surgery than those with a history of less than 2 years.<sup>10)</sup>

With respect to cardiac operations, renal failure is known to increase the morbidity and mortality in patients undergoing cardiac surgery. Durmaz et al. reported eight patients with end-stage renal disease who were on HD, and the mortality and morbidity rates were 12.5% and 75.0%, respectively.<sup>12)</sup>

Although the underlying disease influences long-term survival of patients with NSCLC, radical lung resection is recommended in selected NSCLC patients.<sup>2)</sup> The morbidity and mortality rate of the pulmonary operations conducted in patients on HD is not negligible, and careful metabolic, hematologic, and pharmaceutical management is mandatory during the perioperative period of lung resections. Thoracic surgeons are required to minimize operative stress and

improve perioperative care. Our first case had undergone PCI for coronary stenosis preoperatively, and it may have reduced perioperative cardiac risk. VATS operations also may reduce operative stress and decrease postoperative mortality and morbidity. Although we adapted thoracoscopic operations for patients on HD with lung cancer to reduce operative invasiveness, further investigation was needed to establish its usefulness. Preoperative 3D-MDCT angiography is useful since it encourages understanding of the patient's personal anatomy for VATS.

We used remifentanyl, and propofol during operations. Remifentanyl is a potent selective  $\mu$  opioid receptor agonist that has a rapid onset of action (about 1 min), and it exhibits a predictable rapid metabolism by nonspecific esterases in the blood and tissues and has a context-sensitive half-time of 2–3 min.<sup>13</sup> It is also an attractive agent for use in the setting of renal dysfunction.

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