We report the case of an extremely elderly patient with long-term survival after surgical resection for lung cancer. A 93-year-old man was evaluated for an abnormal density on chest radiography. Chest computed tomography showed a nodular density of 2.5 × 2.5 cm in the left S4b segment. Lung cancer was diagnosed by bronchoscopy, and left posterolateral thoracotomy and S4 segmentectomy were performed. Group 1 lymph node dissection and sampling of the 6th lymph node were also performed. Pathological examination revealed poorly differentiated squamous cell carcinoma without any lymph node metastases. The tumor was staged as p-T1aN0M0 stage IA. No complications were encountered postoperatively, and the patient was discharged. He remains alive as of 5 years postoperatively without any recurrence.

Keywords: elderly, lung cancer, surgery

Introduction

With an aging society, surgery for lung cancer among patients in their 80s is no longer rare. However, surgery for lung cancer in extremely elderly patients in their 90s has rarely been reported. We performed surgical resection for lung cancer in a 93-year-old man who has subsequently shown long-term survival. We now report this case and discuss some of the relevant literature.

Case Report

A 93-year-old man presented with an abnormal density on chest radiography found at another hospital. Family history was unremarkable. Past history was positive for chronic bronchitis, atrial fibrillation, and bilateral knee osteoarthritis. No history of tobacco or alcohol use was present. In terms of history of the present illness, chest radiography during treatment at another hospital for pneumonia showed an abnormal density. The same finding was noted on chest radiography 1 year later, so the patient was referred to our hospital.

On hospital admission, blood test findings revealed no specific abnormalities. Tumor markers were within normal limits: Carcinoembryonic antigen (CEA) 2.9 ng/ml; carbohydrate antigen19-9 (CA19-9), 18.9 U/ml; squamous cell carcinoma antigen (SCC), 0.9 ng/ml; and Cytokeratin Fragment 21-1 (CYFRA), 1.2 ng/ml. Pulmonary function tests showed: VC, 2530 ml; %VC, 100%; FEV1.0, 1160 ml; and FEV1.0%, 51.6%. These findings were consistent with obstructive ventilatory impairment. Chest radiography showed a 2.5-cm diameter nodule with irregular margins in the left lower lung field (Fig. 1A).

Chest computed tomography (CT) revealed an irregular spiculated mass of 2.5 × 2.5 cm with pleural indentation in the left S4b segment. No mediastinal lymph node enlargement was identified (Fig. 1B). Lung adenocarcinoma was diagnosed on exfoliative cytology by bronchoscopy. The clinical diagnosis was c-T1bN0M0. The patient required a cane for walking, but was able to climb stairs, and preoperative performance status was 1. Surgery
was planned after informed consent was obtained. The patient was educated on the perioperative complications associated with lobectomy, which is the common treatment method for lung cancers. He was informed that the postoperative mortality rate among patients in their nonagenarians was 15.4%, which was higher than the 4.5%–8.0% mortality rate among patients in their octogenarians, although the difference was not significant. Additionally, we specified that to prevent postoperative decrease in performance, the patient would have to undergo segmentectomy and resection of the first lymph node group, but not the conventional lobectomy and resection of the second lymph node group. Further, considering that the average life expectancy in Japan at the age of 93 years is 3.47 years and the 5-year survival rate after surgery at the age of 80 years or more is approximately 55%, we suggested that the patient undergo non-operative therapy.

Lung lobectomy was performed via posterolateral thoracotomy. Group 1 lymph node dissection (LND) and sampling of only the 6th lymph node, which appeared enlarged during surgery, were performed. Macroscopically, pathological examination showed a tumor in S4 measuring 2.1 × 1.7 cm as a white solid mass-like lesion. Microscopically, hematoxylin and eosin (HE) staining showed what appeared to be large cell carcinoma, comprising large cells, but some keratinization was noted, with differentiation to squamous epithelium. Occasional ill-defined gland-like structures characteristic of adenocarcinoma were present, but represented ≤10% of the tumor and were considered coincidental.

Based on these findings, poorly differentiated squamous cell carcinoma was diagnosed. No lymph node metastases were identified, and the sampled 6th lymph node was also negative for metastases. The pathologic diagnosis was p-T1bN0M0 stage IA.

No complications were encountered postoperatively, and the patient was discharged on postoperative day 21. Four years postoperatively, the patient was repeatedly hospitalized for dehydration and bronchial asthma. He required assistance for walking, and performance status was 2. As of the time of writing, 5 years after surgery, the patient is bedridden with a performance status of 3–4. However, he has survived without any tumor recurrence.
Discussion

According to nationwide data for surgical lung cancer cases by the Japanese Joint Lung Cancer Registry Committee Lung Cancer in Japan: Analysis of Lung Cancer Registry for Resected Cases in 1999 elderly patients ≥80 years old accounted for 598 (4.5%) of the 13224 registered cases. Lung cancer surgery in octogenarians (age ≥80 years) is thus no longer rare. However, according to the nationwide data, only 4 nonagenarian (age ≥90 years) patients were reported in that year, and much remains unknown regarding the surgical indications or types of surgery. Few detailed descriptions of cases with extremely elderly patients have been reported.

Iwata, et al. reported two cases in men with a preoperative performance status of 1. A 91-year-old patient had a history of hypertension, and pulmonary function testing showed that FEV1.0 was 1450 ml and FEV1.0% was 61.7%, consistent with obstructive ventilatory impairment. A 93-year-old patient experienced mild aortic insufficiency and chronic atrial fibrillation, and pulmonary function showed an FEV1.0 of 1470 ml and FEV1.0% of 47.5%, again consistent with obstructive ventilatory impairment. However, both patients did well postoperatively, encountered no serious complications, and were discharged. Likewise in our patient, the postoperative course was better than expected, with mild bronchial asthma attack as the only complication. Based on these outcomes, as Iwata, et al. stated, if cases are carefully selected, nonagenarians can achieve good surgical outcomes similar to those reported in octogenarians.

In elderly patients, compared to best supportive care (BSC) and radiotherapy, better treatment outcomes with surgery have also been reported. In 2005, Japanese lung cancer treatment guidelines recommended that the indications for lung cancer surgical resection not been decided based on age alone (grade B).

In elderly patients, the incidence of preoperative complications is high, at 20%–40%. In particular, cardiac failure and myocardial infarction are reported as causes of surgical mortality. In some reports, surgical mortality rates of 15.4% have been reported in nonagenarians, which is higher, but not significantly, than the 4.5%–8.0% rate in octogenarians. On the other hand, Port, et al. reported that with advances in anesthetic techniques, perioperative management, and improved surgical techniques, lung cancer surgery cases are carefully selected, then even in elderly patients, the surgical-related mortality rate is not high, at only 1.6%, and the 5-year survival rate is not bad, at about 38%. They thus concluded that in terms of surgical indications, age alone should not be used as a reason for exclusion. In addition, in 49 patients with early-stage disease who did not undergo surgery because of refusal or complications, a mean survival of only 14 months was reported. Surgery is thus a treatment option that should be considered.

In elderly patients with lung cancer, the specific type of surgery that should be performed remains unclear. However, in our patient, performance status decreased more than 4 years after surgery when he was repeatedly hospitalized for dehydration and bronchial asthma attacks. Looking at this type of clinical course, in extremely elderly patients ≥90 years old, life expectancy should be considered. As indications for a surgical procedure, radical cure is not the only concern; minimal surgical invasiveness and preservation of cardiopulmonary function must also be considered.

Mizuguchi, et al. reported that patients with mediastinal LND showed no significant differences in survival rates compared to patients with sampling biopsy alone, but performance status at the time of discharge was decreased following mediastinal LND. They therefore recommended surgery without mediastinal LND in elderly patients. Okami, et al. in a review of nationwide data for patients ≥80 years old who underwent surgery for clinical stage I lung cancer, reported that there were no differences in 5-year survival rates based on the extent of mediastinal LND. In addition, like preoperative...
complications, group 2 LND was also a risk factor for postoperative complications. Group 2 LND was therefore considered excessively invasive in elderly patients, and not to be performed. In a report in non-elderly patients, Izbicki, et al.\(^9\) reported that group 2 LND may improve survival time, and that with group 2 LND, postoperative complications and mortality rate did not increase. Group 2 LND was thus recommended. However, in elderly patients, with group 2 LND, tolerance limits may exist in terms of surgical invasion, so whether group 2 LND should be performed must be carefully decided. This is even more applicable to extremely elderly patients, and group 2 LND, with relatively excessive invasion, should not be indicated. Moreover, surgery should probably be limited to clinical stage c-I, in which complete resection is possible without group 2 LND, and in which a good clinical outcome can be achieved.

The extent of lung resection, whenever possible, should be limited in an effort to preserve as much pulmonary reserve capacity as possible. Non-inferiority of segmentectomy as compared to surgical outcomes with lobectomy has not been confirmed, although a large-scale clinical trial began in Japan in 2009.\(^{10}\) However, it is noteworthy that targets in that study were non-elderly patients \(\leq 75\) years old. In an investigation into octogenarians with lung cancer, Okami, et al.\(^3\) reported limited surgery in 33.2\% of all cases. The 5-year survival rates for limited surgery and lobectomy were 59.8\% and 53.8\%, respectively, and did not differ significantly. Indications for incomplete resection must be avoided, but indications for aggressively performing segmentectomy should be considered. Marked advances have recently been made in thoracoscopy, and surgical experience using video-assisted thoracoscopy (VATS) is accumulating. VATS is advantageous in terms of minimal invasiveness and early getting out of bed, and is a procedure that deserves further investigation.

**Conclusion**

The Annual Statistical Report of National Health Conditions indicates that the average life expectancy in Japan at 93 years of age is 3.47 years. As of the time of writing, the patient has survived 5 years postoperatively, and although his performance status is 3–4, he has survived without any tumor recurrence. In some extremely elderly nonagenarians, lung cancer surgery may still be indicated. For lung cancer patients \(\geq 90\) years old, careful surgical indications concerning not only with radical cure, and procedures in which surgical treatment is not relatively excessive, are needed. Further studies should be conducted.

**Disclosure Statement**

No disclosure.

**References**