

## Left Upper Division Sleeve Segmentectomy for Early Stage Squamous Cell Carcinoma of the Segmental Bronchus: Report of Two Cases

Junzo Shimizu, MD,<sup>1</sup> Yoshinori Ishida, MD,<sup>1</sup> Takahiro Kinoshita, MD,<sup>1</sup>  
Takuro Terada, MD,<sup>1</sup> Yasuhiko Tatsuzawa, MD,<sup>1</sup> Yukimitsu Kawaura, MD,<sup>1</sup>  
Haruhiko Ogawa, MD,<sup>2</sup> and Miwa Imai, MD<sup>3</sup>

Early hilar lung cancer is rare. It is usually curable if properly diagnosed and treated. We recently encountered two cases of early stage squamous cell carcinoma of the left upper division bronchus, which responded well to left upper division sleeve segmentectomy. Case 1 was a 74-year-old man, a heavy smoker, who was referred to our hospital after sputum cytology had resulted in a positive diagnosis while receiving inpatient care for heart failure at another hospital. Bronchoscopy revealed a thickened tumor at the spur between left B<sup>1+2</sup> and B<sup>3</sup>. Squamous cell carcinoma was diagnosed by forceps biopsy via bronchoscopy. Left upper division sleeve segmentectomy with lymph node dissection was performed. Since the bronchi to be anastomosed to each other were greatly different in diameter, telescoped anastomosis was used. His postoperative course was uneventful, and he continues to show good respiratory condition, without any evidence of recurrence 25 months after surgery. Case 2 was a 60-year-old man, a heavy smoker, who was identified by sputum cytology as needing detailed examination during a mass screening of high-risk groups for early detection of lung carcinoma. Bronchoscopy revealed a nodular tumor at the orifice of the left upper division bronchus. Squamous cell carcinoma was diagnosed by forceps biopsy via bronchoscopy. Left upper division sleeve segmentectomy with lymph node dissection was performed. During surgery for this case, the lingular bronchus was dissected obliquely to make its cross-section wide enough to match the diameter of the left upper lobe bronchus to which the former was anastomosed. His postoperative course was uneventful, and he shows good respiratory condition, without any evidence of recurrence five months after surgery. The pathological stage was TisN0M0 (stage 0) in both patients, and their tumors were confirmed as early hilar lung cancer. Sleeve segmentectomy, aimed at radical resection of cancer while preserving lung function, can serve as a standard procedure for surgical treatment of cases of early hilar lung cancer confined to the segmental bronchi. (*Ann Thorac Cardiovasc Surg* 2003; 9: 62–7)

**Key words:** early hilar lung cancer, sleeve segmentectomy, squamous cell carcinoma

### Introduction

As mass screening for lung cancer has become more widespread and bronchoscopy has advanced, the number of patients diagnosed as having early hilar lung cancer has

*From Departments of <sup>1</sup>Surgery and <sup>2</sup>Internal Medicine, Saiseikai Kanazawa Hospital, Kanazawa, and <sup>3</sup>Department of Pathology, Ishikawa Prefectural Nursing University, Kahoku-gun, Japan*

Received July 22, 2002; accepted for publication October 28, 2002. Address reprint requests to Junzo Shimizu, MD: Department of Surgery, Saiseikai Kanazawa Hospital, Ni 13-6, Akatsuchi-machi, Kanazawa 920-0353, Japan.

increased.<sup>1)</sup> The Japan Lung Cancer Society (JLCS) has proposed their own sets of criteria for early hilar lung cancer,<sup>2)</sup> but an internationally accepted set of criteria has not been determined as yet. The JLCS defined early hilar lung cancers as tumors that fulfill the following histological criteria: 1) the lesion is localized proximal to the segmental bronchi, 2) tumor invasion is confined to the bronchial wall, 3) there are no lymph node metastases or distant metastases. Early hilar lung cancer thus defined is sometimes confined to segmental bronchi. When dealing with such cases, radical treatment is theoretically possible by resecting the affected bronchi alone, while pre-

servicing the lung parenchyma. In practice, however, it is not possible to cut the bronchus at a point distal to the segmental bronchus, while preserving the periphery of the lung. Therefore, as a procedure for radical treatment of lung cancer that minimizes lung resection, sleeve segmentectomy has been devised, which involves resection of the affected segment of the lung, adequate resection of the bronchi proximal to the lesion, and post-resection bronchoplasty. In the past, bronchoplasty at the segmental bronchus level was reported for only a small number of cases, and recurrent lung cancer and multiple lung cancer were the primary conditions for which this procedure was used.<sup>3)</sup> We were recently able to treat two cases of early stage squamous cell carcinoma of left upper division bronchus successfully by performing left upper division sleeve segmentectomy. We will present these cases here, along with a discussion of the relevant literature.

## Case Reports

### Case 1

The patient was a 74-year-old man. He was a heavy smoker with a smoking index (average number of cigarettes a day  $\times$  years of smoking history) of 2,000. In June 2000, he was admitted to a local hospital to receive treatment for heart failure. He had a positive sputum cytology (suggesting squamous cell carcinoma) after admission. Bronchoscopy revealed a thickened tumor at the spur between left B<sup>1+2</sup> and B<sup>3</sup>, which was a tumorous lesion slightly elevated as compared to the normal bronchial mucosa (Fig. 1A). Squamous cell carcinoma was diagnosed by forceps biopsy via bronchoscopy. In July 2000, he was referred and admitted to our department to receive surgical treatment. Biochemical tests of blood and urine, conducted on admission, revealed nothing noteworthy. All of the serum tumor markers tested (carcinoembryonic antigen (CEA), squamous cell carcinoma antigen (SCC) and neuron specific enolase (NSE)) were within their normal ranges. Chest X-ray, chest CT scans and Tl scintigrams revealed no abnormalities. All spirometric parameters were approximately normal (VC, 3.05 L; %VC, 102.6%; FEV<sub>1.0</sub>, 2.34 L; FEV<sub>1.0</sub>%, 76.7%). The arterial blood gas analysis yielded favorable results; pH was 7.442, PaCO<sub>2</sub> was 43.2 mmHg, PaO<sub>2</sub> was 87.8 mmHg and BE was 3.8 mmol/L (Table 1). On the basis of these test results, the patient was diagnosed as having early stage squamous cell carcinoma of the segmental bronchus originating from the spur between left B<sup>1+2</sup> and B<sup>3</sup>. Left upper division sleeve segmentectomy with lymph

**Table 1. Results of respiratory function tests**

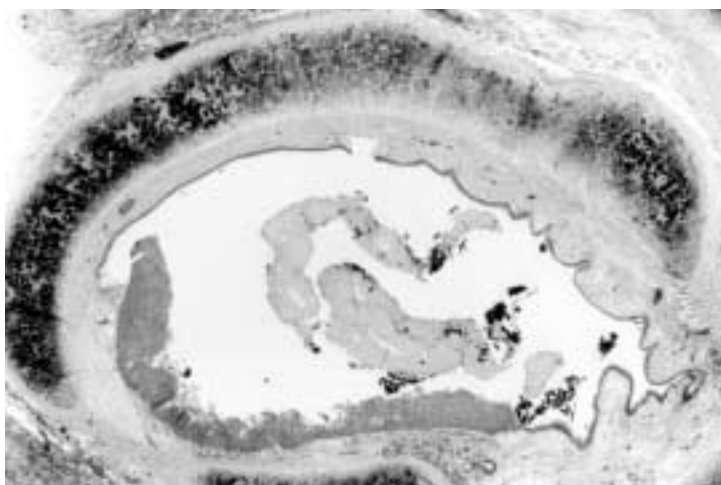
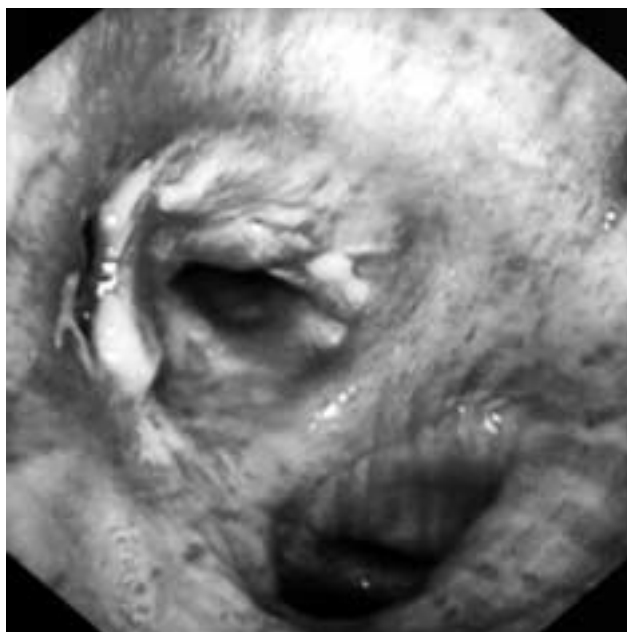
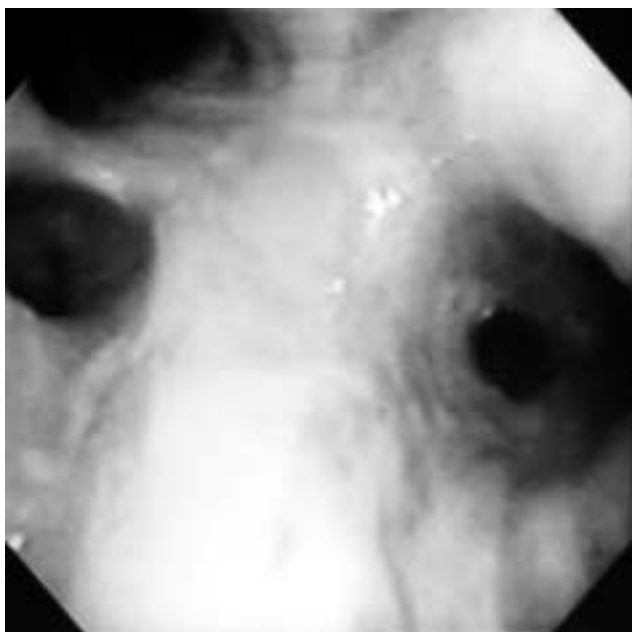
	Case 1		Case 2	
	Pre	Post	Pre	Post
Spirometry				
VC (L)	3.05	2.41	3.04	2.38
%VC	102.6	79.0	85.6	65.6
FEV <sub>1.0</sub> (L)	2.34	1.91	2.02	1.63
FEV <sub>1.0</sub> %	76.7	79.3	66.4	70.0
Blood gas analysis				
pH	7.442	7.439	7.451	7.391
PaCO <sub>2</sub> (mmHg)	43.2	42.3	41.1	42.3
PaO <sub>2</sub> (mmHg)	87.8	73.7	87.3	83.5
BE (mmol/L)	3.8	4.1	5.0	1.0

Pre, values before surgery; Post, values 6 weeks after surgery; VC, vital capacity; FEV<sub>1.0</sub>, forced expiratory volume in 1.0 second; PaCO<sub>2</sub>, arterial pressure of carbon dioxide; PaO<sub>2</sub>, arterial pressure of oxygen; BE, base excess

node dissection (ND2a)<sup>4)</sup> was performed. This procedure involved some technical difficulties, since the bronchi to be anastomosed to each other were largely different in diameter. For this reason, telescoped anastomosis was used in this patient (Fig. 1B). An intraoperative pathology examination of the bronchial stump and all the dissected lymph nodes (#4, 5, 6, 7, 10, 11, 12u, 13) confirmed that the tumor had been completely resected and that there was no nodal metastasis, which met the criteria proposed by the JLCS. The pathological stage was TisN0M0 (stage 0), and it was confirmed as early hilar lung cancer (Fig. 1C). His postoperative course was uneventful, and he continues to show good respiratory condition (Table 1), without any evidence of recurrence 25 months after surgery.

### Case 2

The patient was a 60-year-old man. He was a heavy smoker with the smoking index of 2,400. He was identified by sputum cytology as requiring additional examination during a mass screening of high-risk groups for the early detection of lung carcinoma. He was referred to our hospital for a definite diagnosis by bronchoscopy, which showed a nodular tumor at the orifice of the left upper division bronchus (Fig. 2A). Squamous cell carcinoma was diagnosed by the forceps biopsy via bronchoscopy. In February 2002, the patient was admitted to our department to receive surgery. Biochemical tests of blood and urine on admission revealed nothing noteworthy. All serum tumor markers tested (CEA, SCC and NSE) were

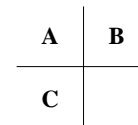
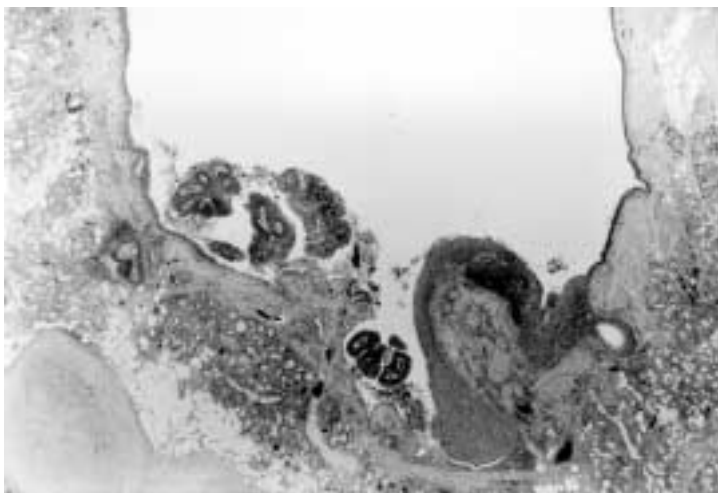
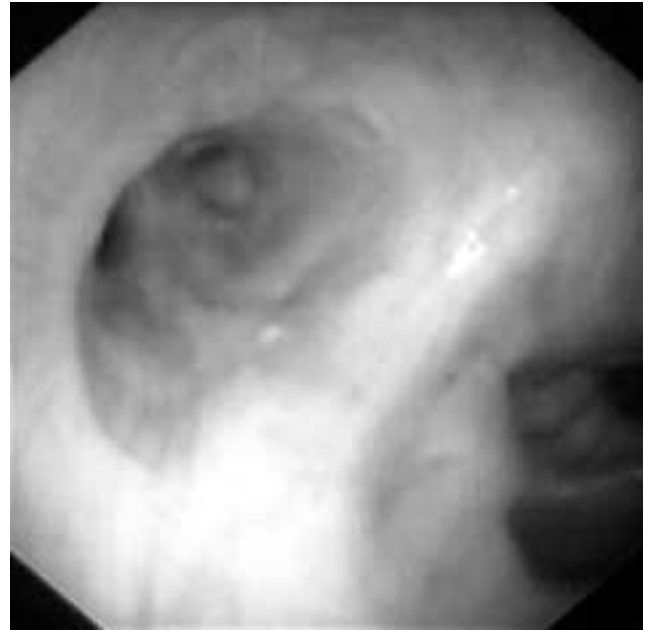
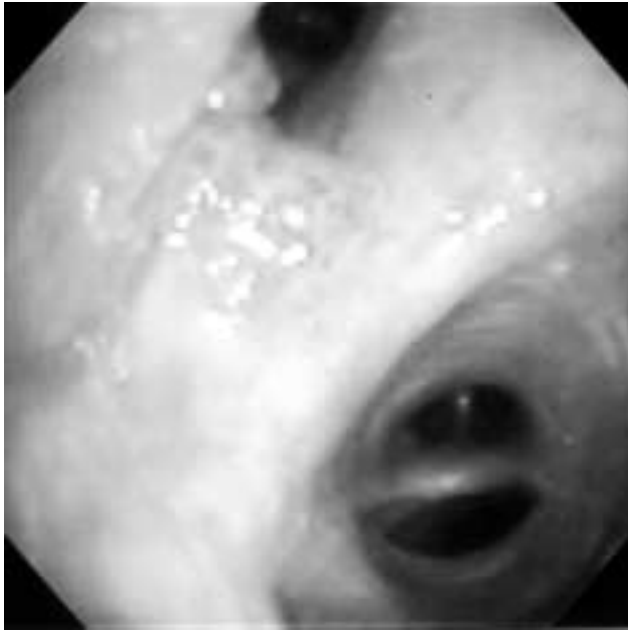


A	B
C	

**Fig. 1.** A: Bronchoscopic view of the left upper division bronchus of Case 1. A thickened tumor can be seen at the spur between B<sup>1+2</sup> and B<sup>3</sup>.  
 B: Postoperative bronchoscopic findings for Case 1. A telescoped anastomosis is visible, but the orifices of the lingular segmental bronchus remain patent.  
 C: Microscopic findings of a thickened tumor of about 1 cm in diameter in Case 1. The histological type was squamous cell carcinoma in situ.

within their normal ranges. Chest X-ray, chest CT scans and Tl scintigrams revealed no abnormalities. Spirometric parameters showed a slightly obstructive pattern (VC, 3.04 L; %VC, 85.6%; FEV<sub>1.0</sub>, 2.02 L; FEV<sub>1.0</sub>%, 66.4%). The arterial blood gas analysis yielded acceptable readings (pH, 7.451; PaCO<sub>2</sub>, 41.1 mmHg; PaO<sub>2</sub>, 87.3 mmHg; BE, 5.0 mmol/L), as shown in Table 1. On the basis of these test results, the patient was diagnosed as having early stage squamous cell carcinoma of the segmental bronchus originating from the orifice of left upper division bronchus. Left upper division sleeve segmentectomy with lymph node dissection (ND2a) was performed. During surgery for this case, the lingular bronchus was dissected

obliquely to make its cross-section wide enough to match the diameter of the left upper lobe bronchus to which the former was anastomosed (Fig. 2B). An intraoperative pathology examination of the bronchial stump and all the dissected lymph nodes (#4, 5, 6, 7, 10, 11, 12u, 13) confirmed that the tumor had been completely resected and that there was no nodal metastasis, which met the criteria proposed by the JLCS. The pathological stage was TisN0M0 (stage 0), and it was confirmed as early hilar lung cancer (Fig. 2C). His postoperative course was uneventful. The patient shows good respiratory condition (Table 1) and no evidence of recurrence five months after surgery.



**Fig. 2.** A: Bronchoscopic view of the left upper division bronchus of Case 2. A nodular tumor can be seen at the orifice of the upper division bronchus.  
 B: Postoperative bronchoscopic findings for Case 2. The orifices of the anastomosed lingular segmental bronchus are smooth and patent.  
 C: Microscopic findings of a nodular tumor of about 7 mm in diameter in Case 2. The histological type was squamous cell carcinoma in situ.

**Discussion**

Early hilar lung cancer is located at sites that can be directly viewed under a bronchoscopy. For this reason, a number of surgeons recommended non-invasive treatment using endobronchial techniques for the treatment of this kind of lung cancer, e.g., photodynamic therapy (PDT)<sup>5,6)</sup> and endobronchial brachytherapy.<sup>7,8)</sup> However, the indications for radical treatment with these techniques are narrower than the indications for surgical treatment. Furthermore, no method of evaluating their efficacy has been established. And limitations also lie in the instruments and facilities needed for these techniques. For these reasons, these non-invasive therapies are applicable to very

few patients. Martini and Melamed<sup>9)</sup> treated 47 patients with occult lung carcinoma and found that only those patients from whom the tumor was excised survived for long periods. In contrast, those patients who were presumed to be in early stages of the disease but were treated by other methods had poor outcomes. Therefore, we deduced that surgery would provide the most reliable means of treatment and we followed a policy of aggressive surgical treatment for these lesions. Other factors which prompted us to select surgical treatment for these lesions are 1) reliable evaluation of both the depth of tumor invasion and the presence/absence of lymph node metastasis are essential for making a definite diagnosis of early hilar lung cancer and 2) surgery is the most reliable means

of making this evaluation at present. Advances in endobronchial ultrasonography in the future would allow more accurate diagnosis of the structures within walls or lymph nodes outside the bronchi.

Standard lobectomy or sleeve lobectomy is a usual surgical technique for early hilar lung cancer originating from segmental bronchi. Sleeve lobectomy has become a standard procedure for the surgical treatment of lung cancer because of its reliable and favorable results.<sup>10</sup> It is a lung-saving procedure that is usually indicated for central tumors, for which the alternative is a pneumonectomy. It preserves normal lung tissue and may enable pulmonary resection to be done in selected patients with inadequate reserve.<sup>11</sup> In contrast, results for bronchoplasty at the level of the segmental bronchi have only been reported for a small number of cases and no papers dealing with a significant number of cases have been published.

Limited surgery has been used to treat lung cancer in cases where lobectomy was not possible for reasons of cardiac and/or pulmonary function or cases where the tumor was recurrent. This kind of surgery has been called compromised operation. In recent years, however, limited surgery has begun to be used even in cases where ordinary surgery is possible.<sup>12</sup> Fujimura et al.<sup>13</sup> made the following statement concerning the indication of segmentectomy for roentgenographically occult squamous cell carcinoma of the lung: patients with lesions that are beyond the range of endoscopic visibility, or if the lesions are greater than 10 mm in longitudinal extension, are candidates for segmentectomy as long as intraoperative examination shows a tumor free bronchial stump and negative lymph nodes. When the cancer is confined to segmental bronchi, we make it a rule to preserve lung tissue as far as possible by using segmentectomy. However, with segmentectomy, if there is not sufficient space for a safe tumor margin, there is a problem of radicality. In this case, sleeve segmentectomy, a technique in which segmentectomy is combined with bronchoplasty, may be indicated. We proposed that sleeve segmentectomy for early hilar lung cancer is indicated in cases where the three histological criteria proposed by the JLCS are satisfied and an adequate margin is difficult to follow by segmentectomy alone.

However, for this procedure to become a procedure of first choice for early hilar lung cancer, the question of the possibility of lymph node metastasis needs to be resolved. Because the absence of lymph node metastasis is a requirement that must be satisfied for a diagnosis of early hilar lung cancer, the hilar and mediastinal lymph nodes

must be dissected adequately and the dissected lymph nodes must be checked immediately by intraoperative pathology examination to confirm the absence of metastasis. The hilar and mediastinal lymph nodes are always dissected adequately, just as is achieved in the standard operation (ND2a). We make it a rule to perform bronchoplasty after an intraoperative pathological examination has confirmed that the dissected lymph nodes are free of metastasis, because this may have important implications in terms of identifying skip lesions. In both of our patients, all the dissected lymph nodes proved to be free of metastases, and no skip lesions were detected. Recently, some investigators<sup>14</sup> introduced an intraoperative sentinel node navigation surgery which would obviate lymph node dissection in non-small cell lung cancer. However, because the existing method of sentinel node detection is not suitable for lung cancer, we think that further study will be required to verify the value of sentinel lymph node biopsy for lung cancer. Saunders et al.<sup>15</sup> reported the results of an evaluation of preoperative FDG-PET imaging for the staging of lung cancer. As for mediastinal staging, they concluded that FDG-PET reduced false-negative and false-positive rates compared to CT because of improved sensitivity, specificity, and accuracy. However, because the sensitivity of FGD-PET was only 70.6%, lymph node dissection cannot be avoided even if preoperative FDG-PET imaging is used for lung cancer. We will maintain our current policy until a consensus is reached on whether lymph node dissection is necessary or not for early hilar lung cancer, provided that this consensus is based on an adequate quantity of data from clinical cases.

In conclusion, two heavy smokers with early stage squamous cell carcinoma of the segmental bronchus underwent left upper division sleeve segmentectomy (a radical but limited surgery) at our facility. This surgical procedure was selected, considering the possibility of the onset of second and third cancers. We believe this procedure allows radical resection of cancer while preserving lung function. For early detection of a second incidence of primary hilar tumor, patients once treated with this procedure will have to receive repeated sputum cytology and bronchoscopy at 6-month intervals.

## References

1. Watanabe Y, Murakami S, Oda M, et al. Surgical management of early stage central (hilar) and peripheral nonsmall cell lung carcinoma. *Cancer* 2000; **89**: 2438–44.

2. Ikeda S. A mass screening for lung cancer. *Rinsho Seijinbyo* 1978; **8**: 841–50.
3. Saito H, Tsunozuka Y, Matsumoto I, Tabata S, Kikkawa H. Two-stage bronchoplasty for synchronous contralateral lung cancers. *Thorac Cardiovasc Surg* 1995; **43**: 176–7.
4. The Japan Lung Cancer Society. General rule for clinical and pathological record of lung cancer. 5th ed., Kanehara, Tokyo, 1999.
5. Cortese DA, Edell ES, Kinsey JH. Photodynamic therapy for early stage squamous cell carcinoma of the lung. *Mayo Clin Proc* 1997; **72**: 595–602.
6. Kato H, Konaka C, Kawate N, et al. Five-year disease-free survival of a lung cancer patient treated only by photodynamic therapy. *Chest* 1986; **90**: 768–70.
7. Saito M, Yokoyama A, Kurita Y, Uematsu T, Miyao H, Fujimori K. Treatment of roentgenographically occult endobronchial carcinoma with external beam radiotherapy and intraluminal low dose rate brachytherapy. *Int J Radiat Oncol Biol Phys* 1996; **34**: 1029–35.
8. Ono R, Hirano H, Egawa S, Suemasu K. Bronchoscopic ultrasonography and brachytherapy in roentgenologically occult bronchogenic carcinoma. *J Bronchol* 1994; **1**: 281–7.
9. Martini N, Melamed MR. Occult carcinomas of the lung. *Ann Thorac Surg* 1980; **30**: 215–23.
10. Watanabe Y, Shimizu J, Oda M, et al. Results in 104 patients undergoing bronchoplastic procedures for bronchial lesions. *Ann Thorac Surg* 1990; **50**: 607–14.
11. Deslauriers J, Mehran RJ, Guimont C, Brisson J. Staging and management of lung cancer. Sleeve resection. *World J Surg* 1993; **17**: 712–8.
12. Yoshikawa K, Tsubota N, Kodama K, Ayabe H, Taki T, Mori T. Prospective study of extended segmentectomy for small lung tumors. The final report. *Ann Thorac Surg* 2002; **73**: 1055–9.
13. Fujimura S, Sakurada A, Sagawa M, et al. A therapeutic approach to roentgenographically occult squamous cell carcinoma of the lung. *Cancer* 2000; **89**: 2445–8.
14. Little AG, DeHoyos A, Kirgan DM, Arcomano TR, Murray KD. Intraoperative lymphatic mapping for non-small cell lung cancer. The sentinel node technique. *J Thorac Cardiovasc Surg* 1999; **117**: 220–4.
15. Saunders CAB, Dussek JE, O'Doherty MJ, Maisey MN. Evaluation of fluorine-18-fluorodeoxyglucose whole body positron emission tomography imaging in the staging of lung cancer. *Ann Thorac Surg* 1999; **67**: 790–7.