

Limited Operation for Lung Cancer in Combination with Postoperative Radiation Therapy

Masanori Kaneda, MD,¹ Fumiaki Watanabe, MD,¹ Tomohito Tarukawa, MD,²
Toshiya Tokui, MD,³ and Takashi Sakai, MD¹

Purpose: Combination therapy of lung wedge resection and postoperative radiation was performed to confirm the procedure's feasibility as a curative therapeutic modality.

Patients and Methods: Among the patients with clinical stage I lung cancer, who could not undergo a standard lobectomy due to their poor pulmonary function, six cases were studied, who agreed with the experimental trial after the informed consent. One patient of clinical N0 with chest wall invasion (T3) was also included in combination with intraoperative chest wall radiation therapy. At first, a wedge lung resection was performed using an auto-suture technique or manual suturing. Two weeks after the surgery, concomitant radiation therapy of the area including the remnant lung around the cancer and the hilum was initiated. Total dose was 40–50 Gy. All of the patients were followed up for more than five years.

Results: All cases tolerated the procedure and survived more than five years. Six were cancer-free. Cancer recurred in only one case. Its manifestation was pleuritis carcinomatosa. Pleural dissemination, which was undetectable at the time of operation, was presumed to be the cause of the recurrence.

Conclusion: This procedure was tolerated and feasible, preventing local recurrence following the limited surgery. (*Ann Thorac Cardiovasc Surg* 2007; 13: 15–20)

Key words: lung cancer, surgery, limited operation, radiation therapy

Introduction

Lobectomy or pneumonectomy is the standard procedure for the surgical treatment of lung cancer. However, it may be difficult to apply this treatment to patients with poor performance status (e.g. low cardiopulmonary function, old age). Segmentectomy or wedge resection may be used as an alternative procedure. However, several studies^{1,2)} revealed higher incidence of locoregional recurrence in this limited resection group. For this reason, a pilot study with a combination therapy of wedge lung resection and

postoperative radiation was performed to confirm its feasibility as a curative therapeutic modality.

Patients and Methods

Among the stage Ia or Ib patients who could not undergo a standard lobectomy due to their poor pulmonary function or advanced age, six cases were studied, who agreed with the experimental trial after the informed consent. All had been confirmed to be clinical N0 stage using a CT scan preoperatively. Wedge lung resection was performed using an auto-suture technique or manual suturing. In the first five cases, complete lymph node dissection was performed, but this only confirmed N0-stage. One or two weeks after the surgery, radiation therapy with a dose of 40–50 Gy, was initiated in an area that included remnant lung around the resected cancer and the hilum (Fig. 1). Another case (case 7), with confirmed clinical N0 but with suspected chest wall invasion (clinical T3),

From ¹*Department of Thoracic Surgery, NHO Mie Chuo Medical Center,* ²*Department of Thoracic and Cardiovascular Surgery, Mie University, Tsu,* and ³*Department of Thoracic and Cardiovascular Surgery, Yamada Red Cross Hospital, Ise, Japan*

Received April 17, 2006; accepted for publication July 3, 2006.
Address reprint requests to Masanori Kaneda, MD: Department of Thoracic Surgery, NHO Mie Chuo Medical Center, 2158–5 Hisai-Myojin-cho, Tsu, Mie 514–1101, Japan.

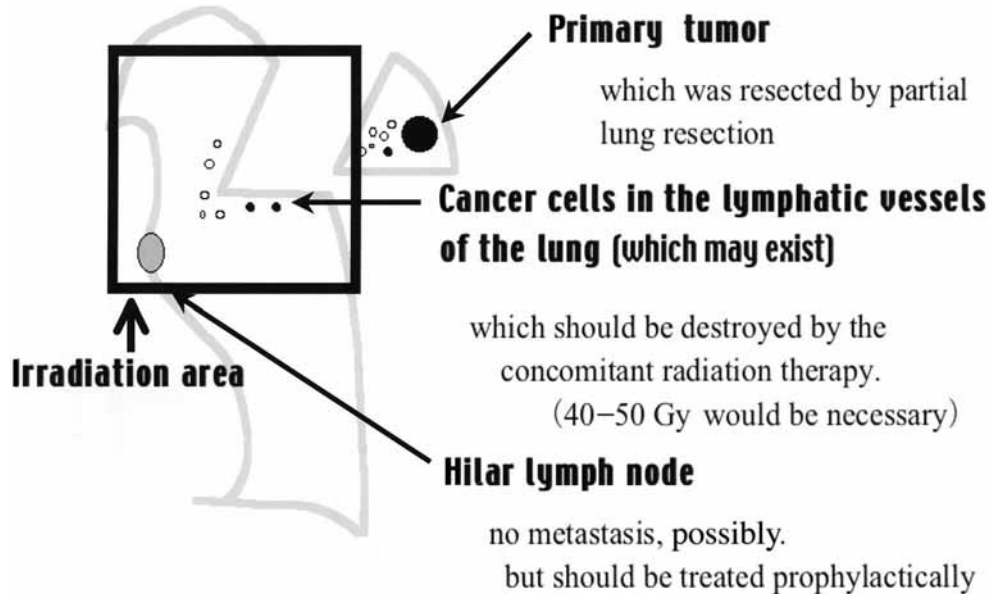


Fig. 1. Schematic presentation of our procedure.

Primary tumor is resected by partial lung resection. Cancer cells in lymphatic vessels of the lung, if present, will be destroyed by concomitant radiation therapy. Hilar lymph node, which contained no metastasis, should be treated prophylactically. The irradiation area is shown in a black square.

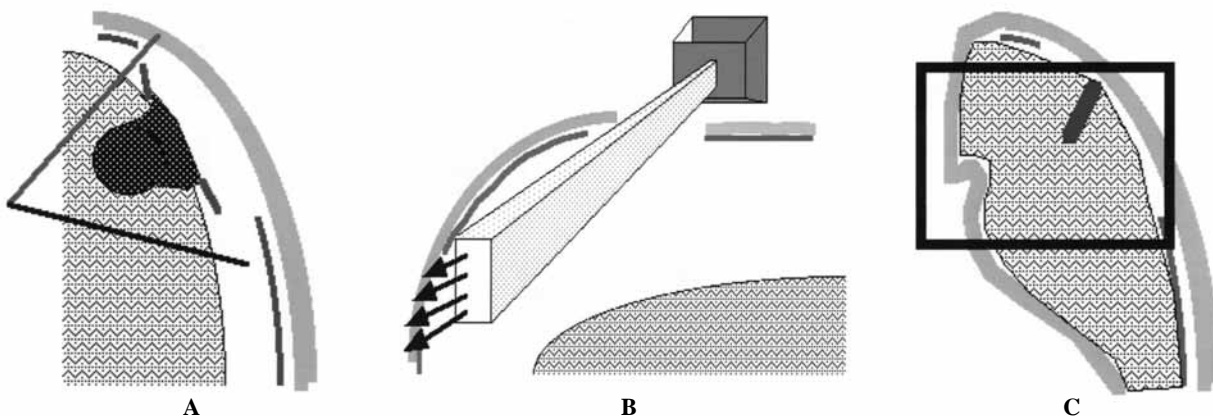


Fig. 2. Treatment planning in Case 7.

A: Initially, a wedge lung resection was performed with partial resection of the parietal pleura, which was invaded by cancer.

B: Following resection of the tumor, intraoperative radiation therapy was performed using an electron beam radiation from the Liniac machine.

C: Concomitant radiation therapy was performed from second to seventh week following the surgery.

was also included as an extended adaptation because he was considered curable in combination with intraoperative chest wall irradiation. Details of this procedure are shown in Fig. 2. All of the patients are followed up for more than five years. Their actual survival was evaluated and survival curve was compared with that of the patient with clinical stage I lung cancer who underwent surgical

resection at our institute for the same period (from 1983 to 1999, n=66).

Results

Profiles of all seven cases are shown in Table 1. Four were male and three were female. Four were squamous cell car-

Table 1. Profile of the patients

Case no.	Age (years)	Sex	Histology	Location	Tumor size (mm)	Stage
1	58	Male	Squamous	ltS ⁴	22	T1N0M0
2	69	Male	Squamous	ltS ⁹	20	T1N0M0
3	76	Female	Adeno.	rtS ⁶	18	T1N0M0
4	80	Female	Adeno.	rtS ⁴	17	T1N0M0
5	73	Male	Squamous	ltS ¹⁺²	18	T1N0M0
6	77	Female	Adeno.	rtS ³	30	T1N0M0
7	80	Male	Squamous	ltS ¹⁺²	40	T3N0M0

squamous, squamous cell carcinoma; adeno., adenocarcinoma.

Table 2. Surgical procedures and doses of radiation

Case no.	Location	Surgical procedure	Total dose of radiation therapy
1	ltS ⁴	Wedge resection	40 Gy/20 Fr
2	ltS ⁹	Wedge resection	40 Gy/20 Fr
3	rtS ⁶	Wedge resection	50 Gy/25 Fr
4	rtS ⁴	Wedge resection	50 Gy/25 Fr
5	ltS ¹⁺²	Wedge resection	50 Gy/25 Fr
6	rtS ³	Wedge resection	50 Gy/25 Fr
7	ltS ¹⁺²	Wedge resection & partial excision of the parietal pleura	50 Gy/25 Fr & 30 Gy/1 Fr (intraoperatively to chest wall)

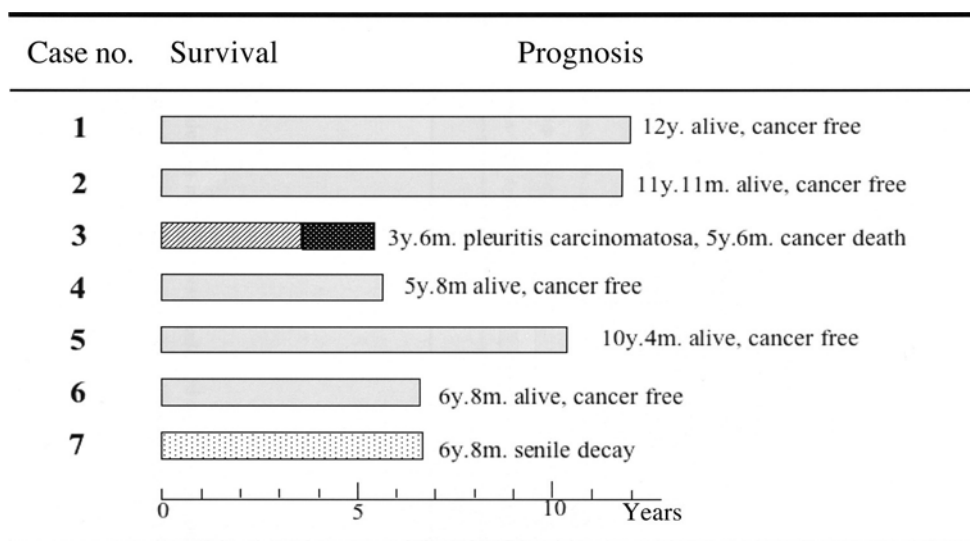


Fig. 3. Survival of the cases.
y, years; m, months.

cinoma, and three were adenocarcinoma. Cases 4 and 7 were elderly. Case 3 had syphilitic aortic valve disease and low cardiac function. The other four cases were selected due to poor pulmonary function. The average tumor size was 23.7 ± 8.5 mm. Surgical procedures and radiation dosages are summarized in Table 2. In case 2, radiation therapy was stopped at the dose of 20 Gy because

the radiotherapist was concerned about irreversible respiratory damage. Medication for bronchial asthma improved the condition of case 2 and he was able to tolerate full radiation.

Radiation-induced lung fibrosis was observed in all cases, but all tolerated the procedure well without deterioration of performance status. All cases survived more

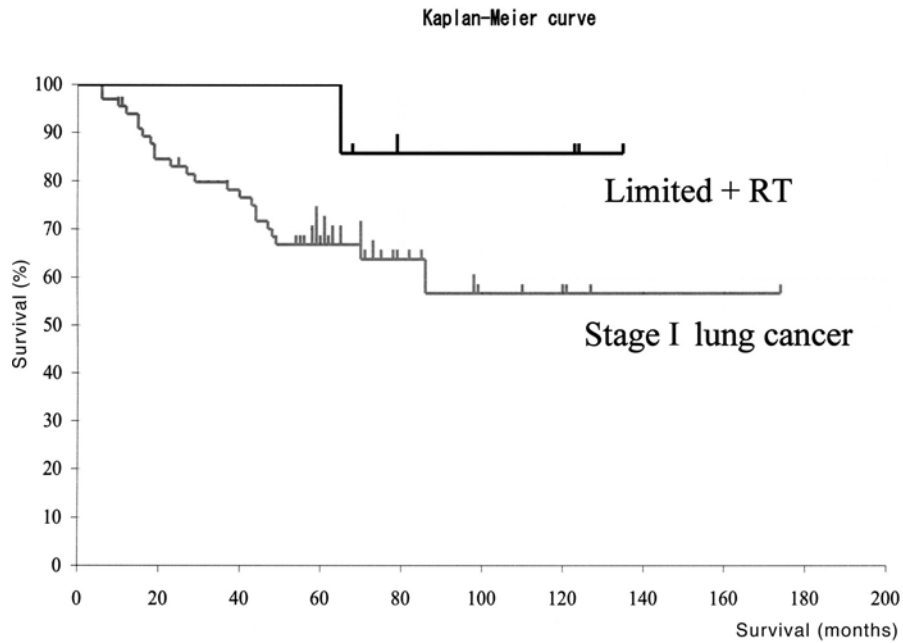


Fig. 4. Survival curve of the limited and radiation group compared with that of stage I lung cancer. RT, radiation therapy.

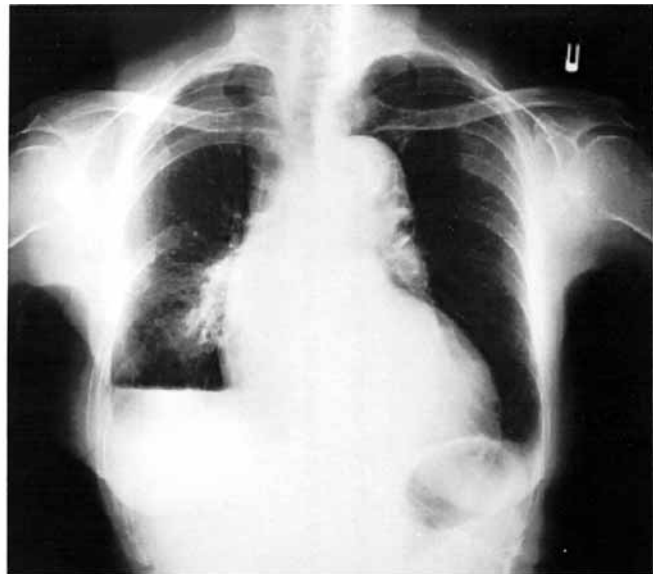
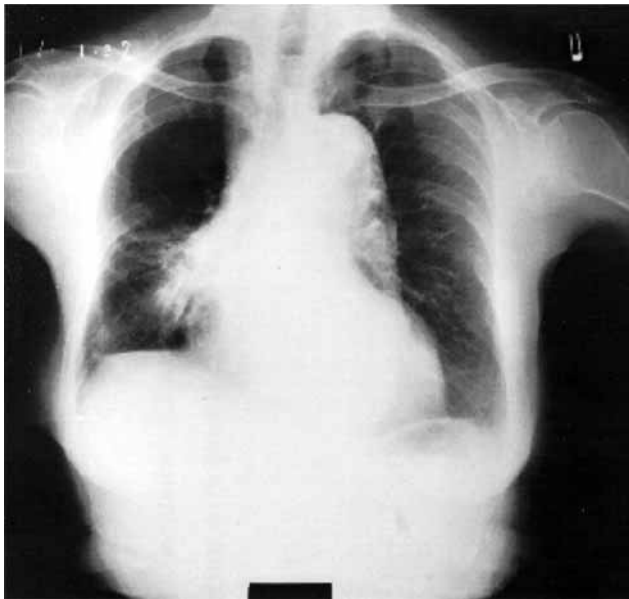


Fig. 5. Chest X-rays of the recurred case.

A: X-ray was taken just after the postoperative radiation therapy.

B: X-ray was taken at the recurrence. Deterioration of the disease in the lung field was not evident.

A | B

than five years (Fig. 3). Six were cancer-free. In case 3, recurrence was confirmed three years and six months after the surgery, and she died from the cancer in five years and six months after the surgery. The survival curve is shown in Fig. 4. Compared with the survival curve of

stage I disease, it appears improved, but with no statistically significant difference.

Chest X-rays in the case of recurrence are shown in Fig. 5. The first manifestation was fluid retention in the thoracic cavity. Cancer cells were confirmed in the pleu-

ral fluid and diagnosed as a pleuritis carcinomatosa. Deterioration of the disease in the lung field was not evident (Fig. 5B). Hence, we concluded that pleural dissemination, which was undetectable at the time of operation, was the cause of the recurrence.

Discussion

Surgical resection is considered to be the modality of choice for the treatment of stage I lung cancer. The standard operation is a lobectomy or pneumonectomy with the dissection of mediastinal lymph nodes. However, these standard operations could not be used in those patients with low performance status. Many of them were candidates of radiation therapy and/or chemotherapy. Limited operations such as segmentectomy or wedge lung resection may be an alternative procedure for these patients. Regarding the safety of the limited operation, Temeck et al.¹⁾ reported a 1.4% perioperative mortality rate and a 4.1% morbidity rate in the study of high-risk patients group who underwent wedge lung resection. Pastorino et al.²⁾ and Hoffmann et al.³⁾ also reported low operative mortality (0%) in the limited resection group compared to the high mortality rate (3–5%) in the lobar resection group. Concerning the long-term outcome of the limited operation, Pastorino et al.²⁾ and Read et al.⁴⁾ reported that the 5-year survival of this group is not different to that of the standard lobectomy group. However, Ginsberg et al.,⁵⁾ Martini et al.⁶⁾ and Miller et al.⁷⁾ reported increased local/regional recurrence and poor survival rates in patients who received the limited operation. This data suggested the necessity for some combination therapy.

Some studies concerning postoperative adjuvant chemotherapy reported a positive effect, but their efficacy remains unproven.⁸⁾ On the other hand, the combination of limited surgery and radiation is frequently performed for the treatment of breast cancer. Regarding a long-term survival, Komaki et al.⁹⁾ and Kurtz et al.¹⁰⁾ reported equivalent results to that of radical mastectomy. Radiation therapy should be more reliable. Radiation therapy may induce lung fibrosis within a few months. Although this may reduce pulmonary function, a slowly progressive deterioration is better tolerated than a sudden deprivation such as surgical resection. Limited surgery with radiation will be a less invasive therapy, if wedge lung resection is performed using video-assisted thoracoscopic surgery (VATS). This may contribute to a shorter hospital stay, less postoperative pain, decreased hospital costs, and better quality of life.

We could not identify the reason for our one recurrence. The first manifestation was pleuritis carcinomatosa. Deterioration of the disease in the lung field was not evident. Our recent study concerning intraoperative pleural lavage cytology demonstrated that P0 or P1 did not guarantee freedom from pleural dissemination.¹¹⁾ It was recommended to search for occult pleural dissemination by intra-thoracic lavage cytology during the operation.

Recently, Asamura et al.¹²⁾ reported that a pure or part solid ground glass opacity (GGO) lesion, signifying an early adenocarcinoma such as Noguchi's type A, could be treated by wedge resection alone without recurrence within five years. Thus, radiation therapy for a pure GGO lesion should not be necessary. Our procedure is best for T1N0 non-small cell disease. It may be used for T2N0 non-small cell disease. For the N1 disease, our procedure will be insufficient. For the N2 disease, it is contra-indicated.

Conclusion

A combination therapy of wedge lung resection and postoperative radiation was well tolerated, preventing local recurrence following limited surgery.

Acknowledgement

The author thanks Mr. Peter Such who advised on and corrected my English.

References

1. Temeck BK, Schafer PW, Saini N. Wedge resection for bronchogenic carcinoma in high-risk patients. *South Med J* 1992; **85**: 1081–3.
2. Pastorino U, Valente M, Bedini V, et al. Limited resection for Stage I lung cancer. *Eur J Surg Oncol* 1991; **17**: 42–6.
3. Hoffmann TH, Ransdell HT. Comparison of lobectomy and wedge resection for carcinoma of the lung. *J Thorac Cardiovasc Surg* 1980; **79**: 211–7.
4. Read RC, Yoder G, Schaeffer RC. Survival after conservative resection for T1 N0 M0 non-small cell lung cancer. *Ann Thorac Surg* 1990; **49**: 391–400.
5. Ginsberg RJ, Rubinstein LV. Randomized trial of lobectomy versus limited resection for T1 N0 non-small cell lung cancer. Lung Cancer Study Group. *Ann Thorac Surg* 1995; **60**: 615–23.
6. Martini N, Bains MS, Burt ME, et al. Incidence of local recurrence and second primary tumors in resected stage I lung cancer. *J Thorac Cardiovasc Surg* 1995; **109**: 120–9.
7. Miller DL, Rowland CM, Deschamps C, et al. Surgi-

- cal treatment of non-small cell lung cancer 1 cm or less in diameter. *Ann Thorac Surg* 2002; **73**: 1545–51.
8. In: A Consensus Report of Post-operative Chemotherapy for NSCLC. 3rd IASLC Workshop, Bruges, 1993.
 9. Komaki R, Cox JD, Kister SJ, et al. Stage I and II breast carcinoma: treatment with limited surgery and radiation therapy versus mastectomy. *Radiology* 1990; **174**: 255–7.
 10. Kurtz JM, Amalric R, Santamaria F, et al. Radiation therapy after breast-conserving surgery for stage I and II mammary carcinoma. Results of the Marseille experience 1961 to 1976. *Strahlentherapie* 1984; **160**: 239–43.
 11. Tarukawa T, Kaneda M, Tokui T, et al. Efficacy of pleural lavage cytology to estimate a surgical prognosis by detecting occult dissemination of cancer cells in the pleural cavity. [abstr.] *Lung Cancer* 2003; **41** (Suppl 2): S272.
 12. Asamura H, Suzuki K, Watanabe S, et al. A clinicopathological study of resected subcentimeter lung cancers: a favorable prognosis for ground glass opacity lesions. *Ann Thorac Surg* 2003; **76**: 1016–22.