En Bloc Resection for Lung Cancer with Chest Wall Invasion

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Background: The aim of this study was to retrospectively assess the results of *en bloc* chest wall plus lung resection for patients with non-small cell lung cancer (NSCLC) invading the chest wall.

Methods: From January 1986 to December 2000, of 1,820 patients having surgery for NSCLC, 42 (2.3%) patients with neoplasms involving the chest wall underwent *en bloc* chest wall and lung resection. Patient demographics, preoperative symptoms, operative procedures, tumor cell type and size, removed nodal status, and pathologic stage were summarized. The 5-year survival rates of the groups were compared.

Results: Postoperative staging revealed 28 were T3N0M0, 4 were T3N1M0, and 10 were T3N2M0. The in-hospital mortality rate was 11.9% (5/42). The mean age was 79.0 ± 2.8 years in the patients who died of complications, which was significantly older than the mean age of 67.9 ± 8.1 years in the patients who survived the surgery (p = 0.005). The overall 5-year survival was 28.4%. The 5-year survival was significantly longer in the patients with negative (N0) nodal metastasis than in those with N1 and/or N2 nodal metastasis (39.6% versus 7.1%, p = 0.01). Eleven patients had tumor involvement of the parietal pleura. Thirty-one patients had tumor involvement of the soft tissue and/or bone. There was no significant difference of 5-year survival rate between the patients with involvement of the parietal pleura only and the patients with involvement of the parietal pleura and the soft tissue and/or bone (10.9% versus 33.5%, p = 0.94).

Conclusion: *En bloc* resection for bronchogenic carcinoma invading the chest wall provides a favorable prognosis in cases without nodal metastasis. Significant postoperative mortality is associated with old age (> 80 years). The 5-year survival rate is not significantly different between the patients with involvement of the parietal pleura only and the patients with involvement of the parietal pleura and the soft tissue and/or bone. [*J Chin Med Assoc* 2006;69(4):157–161]

Key Words: chest wall, *en bloc* resection, lung neoplasm

Introduction

Lung cancer remains a common cause of cancer deaths worldwide. Most patients with lung cancer do not have the option of surgical treatment when diagnosed because of advanced disease. Even for patients receiving surgical resection of lung cancer, the prognosis has not been satisfactory, unless the disease was at an early stage. Mountain[1] revised the staging system in 1997 and downstaged T3N0M0 to stage IIB as a result of favorable survival in patients with chest wall invasion, but without nodal metastasis. Some series advocated that *en bloc* resection of the chest wall and lung is the procedure of choice to obtain complete resection in lung cancer invading the chest wall.[2–4] In contrast, Elia and associates[5] demonstrated no statistical significance in 5-year survival between the "extrapleural dissection" and the "*en bloc*" resection groups. The authors concluded that surgical treatment of stage IIB and IIIA non-small cell lung cancer (NSCLC) invading the chest wall by extrapleural

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or "*en bloc*" resection is widely adopted and justified by the good results, in terms of morbidity and relief of pain. Survival always depends on the nodal status. The purpose of this study was to retrospectively assess the results of *en bloc* resection of chest wall and lung for NSCLC in a 15-year period and investigate the prognostic factors of long-term survival.

Methods

From January 1986 to December 2000, of 1,820 patients having surgical treatment for NSCLC at Taipei Veterans General Hospital, 42 (2.3%) patients with neoplasms invading the chest wall underwent *en bloc* chest wall and lung resection. The median age was 69.2 ± 8.5 years (range, 39–81 years). The cut-margin of chest wall was at least 2 cm away from the tumor in all cases. Patients with incomplete resection and extrapleural dissection for chest wall invasion were excluded from the study. *En bloc* resection of the chest wall and the lung was defined as removal of lung parenchyma in continuity with parietal pleura and chest wall soft tissue with bony structures. Extrapleural resection was defined as extrapleural dissection of the tumor from the chest wall with removal of lung parenchyma and a portion of the overlying parietal pleura.[4] If defects of the chest wall were more than 5 cm in size after surgery, chest wall reconstruction with mesh repair was carried out unless the defect was located underneath the scapula. During the study period, mediastinoscopy was not performed. Epidural catheterization for pain control was performed routinely. Adjuvant chemotherapy or irradiation was given in cases of lymph node metastasis. Medical charts were retrospectively reviewed, including patient demographics, preoperative symptoms, operative procedures, tumor cell type and size, removed nodal status, pathologic stage, and survival. Follow-up data were obtained by means of telephone contact and/or office visit. Cancer was staged according to the revised international staging system.[1] The depth of chest wall invasion was grouped into 2 categories on the basis of the pathologic report: parietal pleura only and soft tissue and/or bone invasion. The same attending surgeon reviewed all pathologic reports. In-hospital mortality was defined as death within 30 days of surgery and death that occurred later but during the same hospitalization. Continuous variables were summarized as mean and standard deviation (SD), and categorical variables as percentage of proportion. Mann-Whitney *U* test was used to compare the age difference between the in-hospital mortality group and the other patients. Risk factors included in the survival analysis were: smoking history, number of rib resections, number of lymph node dissections, tumor size, depth of chest wall invasion, node metastasis, and tumor cell type. Survival curves of a risk factor at the different levels were compared with log-rank test, and p values of less than 0.05 were considered significant.

Results

The demographic data are summarized in Table 1. Thirty-three patients died (78.5%; in-house mortality) in this study, and 9 patients were alive by the closing date of the study. Mean follow-up time was 36 months. In-hospital mortality was 11.9% (5 of 42).

Table 1. General data of patients with lung cancer invading the chest wall

No. patients	42
Sex, *n* (%)	
Male	41 (97.6)
Female	1 (2.4)
Age, mean ± SD	69.2 ± 8.5
Mean follow-up time, mo (range)	36 (1–178)
No. smokers, *n* (%)	34 (81.0)
Pack-years, mean	30.2
Symptoms, *n* (%)	
Chest pain	20 (47.6)
Cough	19 (45.2)
Hemoptysis	13 (31.0)
Tumor diameter, cm,	
mean ± SD (range)	7.0 ± 2.7 (2.7–12)
Parietal pleural invasion, mean	5.15
Soft tissue/bone invasion, mean	7.62
No. lymph node dissections, *n* (%)	
≤ 15	24 (57.1)
> 15	18 (42.9)
Operative procedures, *n* (%)	
Lobectomy	35 (83.3)
Bilobectomy	1 (2.4)
Pneumonectomy	5 (11.9)
Wedge resection	1 (2.4)
Ribs resected, *n* (%)	
1 rib	8 (19.0)
2 ribs	15 (35.7)
3 ribs	10 (23.8)
4 ribs	7 (16.7)
5 ribs	1 (2.4)
6 ribs	1 (2.4)

Three patients died of pneumonia with respiratory failure. The other 2 patients died of bronchopleural fistula and upper gastrointestinal bleeding, respectively. These 5 patients were significantly older than the others in the study (79.0 ± 2.8 versus 67.9 ± 8.1 years, 2-sample t test, $p = 0.005$). The survival analysis is summarized in Table 2. The overall 5-year survival was 28.4%. Statistical significance of 5-year survival between groups is only seen in the with or without nodal metastasis comparison. The 5-year survival was significantly longer in the patients with negative (N0) nodal metastasis than those with N1 and/or N2 nodal metastasis (Figure 1). The 5-year survival rate was not significantly different between the patients with involvement of the parietal pleura only, and those with involvement of the parietal pleura and the soft tissue and/or bone (10.9% with 23 months median

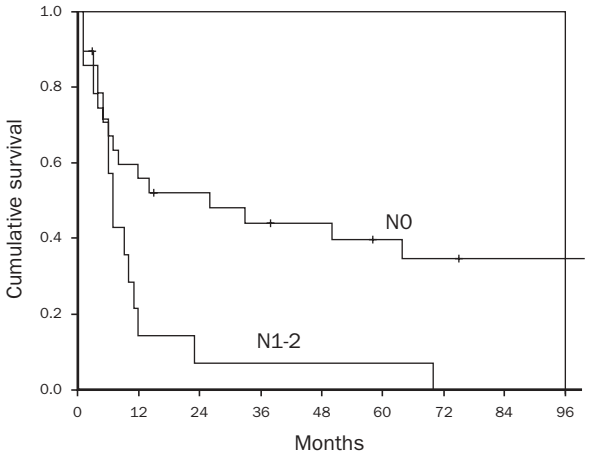

Figure 1. The survival curve of the patients with or without nodal metastasis ($p = 0.01$).

Table 2. Comparison of long-term survival of patients between groups ($n = 42$)

	n (%)	Median survival, mo	5-year survival, %	*p* value
Patients	42		28.4	
Smoking				
< 30 PPD × years	19 (45.2)	7	21.0	0.32
≥ 30 PPD × years	23 (54.8)	14	35.5	
Ribs resected				
≤ 2	23 (54.8)	7	20.2	0.35
> 2	19 (45.2)	23	39.1	
Tumor size, cm				
≤ 6	21 (50%)	14	39.1	0.36
> 6	21 (50%)	7	25.2	
No. of lymph node dissections				
≤ 15	24 (57.1)	7	25.0	0.42
> 15	18 (42.9)	14	32.3	
Nodal metastasis				
N0	28 (67.6)	26	39.6	0.01*
N1 and/or N2	14 (32.4)	7	7.1	
Chest wall invasion				
Parietal pleural	11 (26.2)	23	10.9	0.94
Soft tissue and/or bone	31 (73.8)	8	33.5	
Tumor cell type				
Squamous cell carcinoma	24 (57.1)	9	33.3	0.76
Adenocarcinoma	9 (21.4)	14	16.7	
Adenosquamous	3 (7.1)	–	–	
Others	6 (14.2)	–	–	
Adjuvant radiotherapy				
With	15 (35.7)	7	20	0.156
Without	27 (64.3)	12	31.8	

PPD × years = packs per day × years of smoking.
**The 5-year survival was significantly different between the N0 and N1/2 patients by log-rank test (p < 0.05).*

versus 33.5% with 8 months median, $p = 0.94$). There was no significant difference in 5-year survival rates between patients with squamous cell carcinoma and patients with adenocarcinoma (33.3% with 9 months median versus 16.7% with 14 months median, $p = 0.76$). Adjuvant radiotherapy also had no impact on survival ($p = 0.156$).

Discussion

Controversy exists as to whether full-thickness chest wall resection is necessary in all patients, especially those with invasion only to the parietal pleura. Although some authors[6,7] reported their experiences of extrapleural dissection and *en bloc* resection for chest wall invasion, and found that survival was not significantly affected by the operative procedure, it is always debatable if the completeness of resection can be achieved by extrapleural dissection and confirmation by intraoperative biopsy on the deeper and nearby tissue. Trastek et al[8] reported an improved survival with a chest wall resection as compared with extrapleural resection. In the series of Albertucci et al,[3] the rate of local recurrence was significantly lower in patients undergoing *en bloc* chest wall resection than in patients undergoing extrapleural resection. The 5-year survival rate was better in patients after *en bloc* resection of the chest wall than in those with extrapleural resection in the absence of lymph node metastasis. Actually, it is sometimes not easy to identify the extent of tumor invasion into the chest wall from the preoperative image study unless there is apparent rib destruction or intercostal muscle involvement.[9] It is also not easy to decide if the tumor invasion is only limited to the parietal pleura at exploration. From previous reports,[6,7,10,11] we observed that the patients receiving full-thickness resection of the chest wall were more likely to have soft tissue and/or bone invasion than to have parietal pleura invasion only. We had the same finding in our series. This may explain the higher percentage of incomplete resections and local recurrence in the patients who underwent extrapleural dissection if the tumor adhered closely to the chest wall.

Our study showed significantly higher 5-year survival in the patients with negative (N0) nodal metastasis than in those with N1 and/or N2 nodal metastasis (39.6% versus 7.1%, $p = 0.01$). In 1997, the International Staging System for Lung Cancer[1] revised T3N0M0 from stage IIIA to stage IIB in consideration of favorable survival reported following extended resection of the chest wall in cases without lymph node involvement. The 5-year survival can go up to 61.4% in N0 cases, according to the report by Facciolo et al,[4] a series enrolling 104 patients having *en bloc* chest wall and lung resection for lung cancer invading the chest wall. Because of poor 5-year survival in the patients with positive local lymph node metastasis, some authors recommended conducting a clinical trial with or without induction chemotherapy before proceeding to surgery for these T3N1–2 patients. The mediastinoscopy, a useful tool for preoperative staging for lung cancer, should be performed as the preoperative assessment for patients with suspected lymph node metastasis and chest wall involvement.[6,10]

Our study consisted of a unique group of patients, including 41 men and only 1 woman of relatively old age. The 5 patients who died of postoperative complications had a mean age of 79.0 years (range, 74–81 years), which was significantly older than the patients who survived the operation. Many surgeons have been concerned about the high mortality associated with chest wall and lung resection.[2] Martin-Ucar et al[12] also reported that, in cases of lung cancer with chest wall invasion, *en bloc* pulmonary and chest wall resection was associated with a significantly increased 60-day mortality. The number of rib resections in our 5 patients was 1 resection in 2 patients, 2 resections in 1 patient, and 4 resections in 2 patients. The mean segmental rib resection was 2.6. The procedures that these patients received included 3 lobectomies, 1 wedge resection, and 1 pneumonectomy. The extent of resection and the operative procedure of these patients did not differ from other patients. A more careful preoperative evaluation, such as mediastinoscopy or positron emission tomography scan, is recommended in elderly people if extensive chest wall plus lung resection is to be done.

For patients of lung cancer with chest wall invasion, long-term survival is influenced by completeness of the resection and the nodal status. In our series, the patients with soft tissue or bone invasion had better 5-year survival than patients with parietal pleura invasion only, although the difference was not statistically significant. Chapelier et al[10] reported the depth of chest wall invasion as an independent factor affecting long-term survival. In contrast, McCaughan et al[13] did not find the depth of chest wall invasion influenced survival unless there was lymphatic metastases. Pitz et al[6] also reported no relationship between survival and the depth of chest wall invasion. Our scrutiny found that 5 (45.4%) of 11 patients with parietal pleura invasion had N1 or N2 nodal metastasis, while only 9 (29.0%) of 31 patients with soft tissue or bone invasion had N1 or N2 nodal invasion. Among the patients without nodal involvement, better survival was

evidenced in those with soft tissue or bone invasion than in those with parietal pleura invasion only (median survival: 33 versus 14 months; 5-year survival rate: 41.7% versus 50.0%), although the difference did not reach statistical significance ($p = 0.816$). The reason why patients with parietal pleura invasion were more likely to have lymphatic metastasis was not determined in our series. Other various factors, including tobacco use, number of lymph node dissections, tumor cell type, tumor size, and the extent of chest wall resection, seemed not to affect the survival in our series. In the series of Riquet et al,[14] the use of adjuvant therapy seemed to have little influence on survival of patients having lung cancer with chest wall invasion. Burhart et al[11] observed the best survival in women with T3N0M0 disease. Piehler et al,[15] in their early report, stated that, among patients with T3N0M0 neoplasms, 5-year survival was 84.6% for those younger than 60 years of age and 27.7% for those older than 60.

In conclusion, *en bloc* resection for bronchogenic carcinoma invading the chest wall provides a favorable prognosis in cases without nodal metastasis. The depth of chest wall invasion does not affect the 5-year survival. Significant postoperative mortality is associated with age older than 80 years. Careful preoperative evaluation is advocated to prevent serious complications in this patient group.

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