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## Usefulness of video-assisted thoracic surgery in the management of advanced lung cancer in relation to exploratory thoracotomy

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### ABSTRACT

We analyzed 47 patients who underwent exploratory thoracotomy (thoracotomy without resection) for advanced primary lung cancer. After the introduction of video-assisted thoracic surgery (VATS), we studied its usefulness and compared it with exploratory thoracotomy in marginal cases. Between 1978 and 1991, exploratory thoracotomy was performed on 7% of primary lung cancer patients with bulky N2 disease, intrapulmonary metastasis (pm) and/or pleural dissemination. After the introduction of VATS, this decreased to 5.8% (4 of 69 cases). Although there was no significant difference in the incidence after the introduction of VATS, exploratory thoracotomy was avoided in 5 cases by using VATS. Bulky N2 disease in the subaortic nodules was also diagnosed via VATS. We conclude that VATS is useful in the diagnosis of pm and/or pleural dissemination and in avoiding unnecessary exploratory thoracotomy. *Ryukyu Med. J.*, 17(1)25~30, 1997

Key words: exploratory thoracotomy, video-assisted thoracic surgery, intrapulmonary metastasis, pleural dissemination

### INTRODUCTION

In spite of careful preoperative evaluation of lung cancer patients, several studies report that 5% to 10% of patients were found to have nonresectable lesions for which exploratory thoracotomy was performed<sup>1-3)</sup>. Whenever possible, exploratory thoracotomy should be avoided because it impairs the quality of life in patients suffering from advanced lung cancer. VATS has been found to be useful in diagnosing and treating pulmonary and pleural lesions with minimal invasion<sup>4,5)</sup>. We analyzed 47 patients who underwent exploratory thoracotomy during the 14 years prior to the introduction of VATS in our hospital. In addition, after its introduction, we studied the usefulness of VATS in avoiding exploratory thoracotomy.

### PATIENTS AND METHODS

From 1978 to 1991, (before the introduction of VATS,) 673 patients were admitted to undergo thoracotomy for primary lung cancer at National Okinawa Hospital. Forty-seven (7%) of these patients underwent exploratory thoracotomy. Of these 47 patients, 38 were men and 9 were women, ranging in age from 36 to 77 years (mean age; 61

years). After the introduction of VATS in 1992, we performed thoracoscopic examinations before surgery on those cases that were considered to be marginal candidates for thoracotomy. In 1992, 69 patients with primary lung cancer were admitted for thoracotomy. Clinical stages of lung cancer was determined by physical examination, chest radiograph, computed tomography (CT) scan of the chest, brain, and abdomen, ultrasonography of the abdomen, bone scintigraphy and bronchoscopy. Staging mediastinoscopy was not done. VATS was performed under general anesthesia with a double lumen tube for one-lung ventilation. Partial lung resection or tumor biopsy was performed by using endoscopic staplers or forceps.

### RESULTS

#### 1. Exploratory Thoracotomy Cases Before Introduction of VATS

Histological types of the exploratory thoracotomy cases included 22 adenocarcinomas, 19 squamous cell carcinomas, 3 small cell carcinomas, and 3 other types of carcinoma. The evidence and incidence of exploratory thoracotomy are shown in Table 1. Nineteen cases (40.4%) were found to be nonresectable because of the N factor, including significant N2 or N3 disease, and 18 cases

Table 1 Evidence and incidence of exploratory thoracotomy

Evidences	Cases (%)	Evidences	Cases (%)
N factor (mediastinal bulky N)	19 (40.4)		
T factor	18 (38.8)	N and T factor	10 (21.3)
PM	7	PM	7
Dissemination	3	Dissemination	1
Mediastinum	3	Mediastinum	0
Spine	2	Spine	1
Great vessel	2	Great vessel	1
Chest wall	1		

PM=intrapulmonary metastasis; Dissemination=pleural dissemination

Table 2 Preoperative and thoracoscopic diagnosis in cases avoiding exploratory thoracotomy

Case	Preoperative Diagnosis	Thoracoscopic Diagnosis
1	Miliary shadows	pm2
2	Two pulmonary nodules	D1, effusion cytology of malignancy (+)
3	PM suspected	D1, effusion cytology of malignancy (-), pm2
4	T2N2, CEA 110 ng/ml	pm2
5	Small amount of effusion and PM suspected	D2, effusion cytology of malignancy (+), pm2

PM=Intrapulmonary metastasis; pm2=Intrapulmonary metastasis histologically proven in two lobes; D1=Mild pleural dissemination; D2= Severe pleural dissemination

(38.3%) were nonresectable because of the T factor. In T factor cases, 7 had intrapulmonary metastases (pm); 3, pleural dissemination; and 3, direct mediastinal invasion. Another 10 cases (21.3%) were nonresectable because of the presence of both T and N factors. In these 10 cases, 7 had pm. There was one postoperative death, within 30 days after surgery. Almost all patients were treated with mild chemotherapy or radiotherapy. Median survival of these 47 patients was 10 months, 1-year survival rate was 33%, and 2-year survival rate was 6%. One patient with adenocarcinoma of the right lung survived more than 5 years. He was found to have nonresectable disease because of bulky N2 disease and was treated by intra-arterial infusion of mitomycin C and nimustin through the bronchial artery.

## 2. After Introduction of VATS

Nine (13%) of 69 patients were judged to be marginal candidates under conventional preoperative evaluation and underwent VATS. VATS was indicated in four cases (case 1,2,3,4) because of suspected pm and/or pleural dissemination. VATS was indicated in case 5 because of high serum CEA level. Three cases (case 6,7,8) were suspected as having bulky N2 disease. VATS was indicated in case 9 because of having double cancer.

a. There were 5 cases in which exploratory thoracotomy was avoided by using VATS (Table 2)

Case 1. A 64-year-old woman whose transbronchial lung biopsy (TBLB) of a coin lesion in the right lower lobe revealed adenocarcinoma. Chest CT scan showed miliary

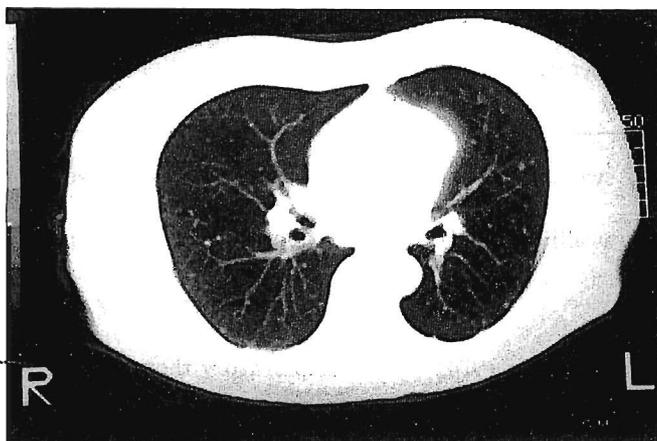


Fig. 1 Chest CT scan showing miliary shadows in bilateral lung level. It is difficult to make an accurate diagnosis whether they are pm or not.

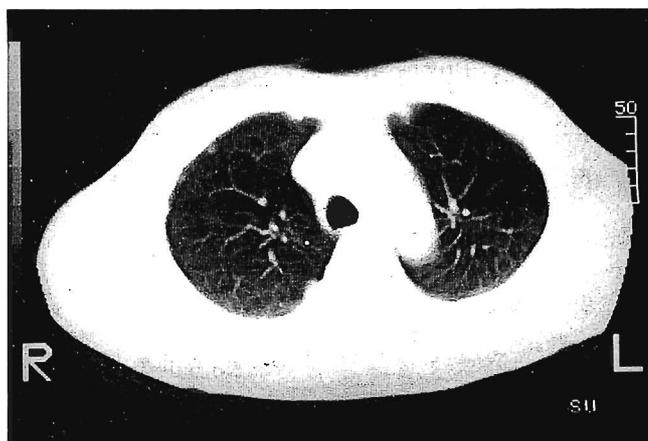


Fig. 3 Chest CT scan showing two pleural nodules without effusion (primary tumor is not seen at this level). It is difficult to make an accurate diagnosis whether it is pleural dissemination or not.



Fig. 2 Thoracoscopy showing many miliary nodules beneath the visceral pleura.

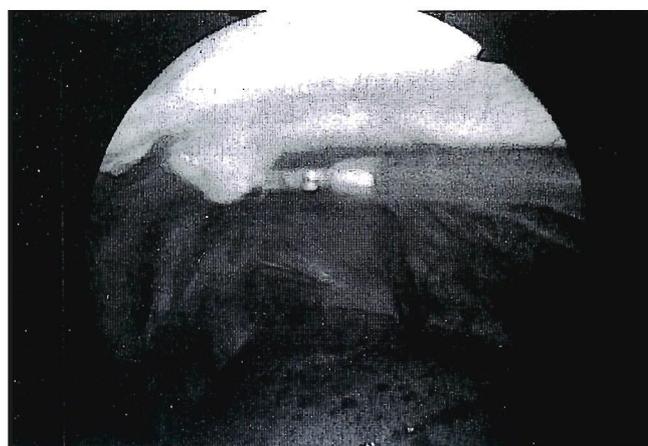


Fig. 4 Thoracoscopy showing two soft nodules on the parietal pleura.

shadows in bilateral lung fields (Fig. 1) and swollen mediastinal lymph nodes. Clinical diagnosis was T1N0M0 or T1N2M1; VATS revealed many small nodules beneath the visceral pleura (Fig. 2). Pulmonary metastases were confirmed by microscopic examination of the partially resected lung using thoracoscopy. The patient died of respiratory insufficiency 15 months later.

Case 2. A 63-year-old man with an abnormal shadow in the right upper lobe on chest radiograph. Adenocarcinoma was suspected from findings of chest CT scan showing two pleural nodules without pleural effusion (Fig. 3); however, histological diagnosis was not evident. Clinical stage was T1N0M0 or T4N0M0. During VATS, two soft nodules on the parietal pleura were noted and confirmed by biopsy as pleural dissemination (Fig. 4). Cytological examination of the effusion revealed malignancy. Pleurodesis was performed using an anticancer drug, but the patient died of contralateral carcinomatous pleurisy 12 months later.

Case 3. A 62-year-old man whose two tumor lesions, one in the left upper lobe and the other in the left lower lobe, were seen on a chest CT scan. The larger tumor in the upper lobe was diagnosed as adenocarcinoma and the smaller one in the lower lobe as nonmalignancy via TBLB. VATS showed mild pleural dissemination, but cytology of the pleural effusion was negative for malignancy. The tumor in the lower lobe was removed with thoracoscopy and confirmed as adenocarcinoma. The patient died 11 months later.

Case 4. A 74-year-old woman whose chest CT scan suggested two small pleural tumors in the right upper lobe and a small amount of pleural effusion. VATS showed severe carcinomatous pleurisy with pm and positive cytology of effusion. The patient died 2 months later.

Case 5. A 78-year-old woman with adenocarcinoma in the left upper lobe, T2N2M0. VATS was indicated be-

Table 3 Preoperative and thoracoscopic diagnosis and operation in cases with thoracotomy converted from VATS

Case	Preoperative Diagnosis	Thoracoscopic Diagnosis	Operative Findings	Operation Performed
6	#5 swelling	#5 swelling	#5 swelling and fixed	Exploratory thoracotomy
7	#5 swelling	#5 swelling	#5 swelling and fixed	Exploratory thoracotomy
8	#5 swelling	No swelling	n0	Left pneumonectomy
9	T3N2	No bulky n2, PM or pleural dissemination	Aortic invasion(T4)	Exploratory thoracotomy

#5=Station 5 (para-aortic) Lymph node; PM=Pulmonary metastasis;  
n0=No lymph node metastasis histologically proven

cause of high serum CEA level (110 ng/mL). Intrapulmonary metastases (pm), preoperatively unsuspected, became evident by thoracoscopic biopsy and therefore thoracotomy was avoided. However, pm still could not be detected on the chest CT scan. The patient is alive with moderate pleural effusion 24 months after VATS.

b. There were 4 cases with thoracotomy converted from VATS (Table 3)

Case 6. A 68-year-old man with hoarseness for 2 weeks prior to admission. Preoperative diagnosis was squamous cell carcinoma of the left upper lobe, T2N2M0. VATS showed swelling of Botallo's lymph nodes (station 5). A thoracotomy converted from VATS was performed with findings of swollen station 5 nodes, subcarinal nodes (station 7), and contralateral hilar nodes. The tumor was nonresectable because of N3 disease. The patient died 6 months later.

Case 7. A 68-year-old man with swelling and fixed mediastinal lymph nodes (station 5) confirmed by thoracotomy converted from VATS. The tumor in this case was as nonresectable as in case 6.

Case 8. A 55-year-old woman whose chest CT scan demonstrated swollen station 5 mediastinal nodes; however, no lymph node swelling was evident upon thoracoscopic examination. Left pneumonectomy and mediastinal node dissection were performed. No lymph node metastasis was evident upon microscopic examination.

Case 9. A 70-year-old man who complained of back pain. Chest CT scan revealed a lung tumor in contact with both the chest wall and the descending aorta. Preoperative diagnosis was T3N2M0 squamous cell carcinoma of the left upper lobe, and left pneumonectomy was indicated. The patient was also found to have gastric carcinoma, which indicated the need for a total gastrectomy. Physical status was good. The patient and his family preferred surgery.

VATS showed no evidence of dissemination, pm, or mediastinal lymph node swelling; therefore a thoracotomy was performed. However, the tumor was not resectable due to its invasion into the chest wall and the aorta.

3. There was one case that involved exploratory thoracotomy without consideration of VATS

Case 10. A 70-year-old man who previously had surgery for a cerebral aneurysm and aortic valve stenosis. The patient was diagnosed adenocarcinoma of the right upper lobe, T2N0M0; a right upper lobectomy was planned. Thoracotomy showed pleural dissemination, and the tumor was deemed nonresectable. Later, chest CT scan showed no evidence of pleural dissemination.

4. Comparison between before and after the introduction of VATS.

The incidence of exploratory thoracotomy after the introduction of VATS was 5.8% (4 of 69 cases). Although there was no significant difference in the incidence after the introduction of VATS, exploratory thoracotomy was avoided in 5 cases by using VATS.

## DISCUSSION

Exploratory thoracotomy impairs the quality of life in advanced lung cancer patients, especially in terms of post-thoracotomy pain. Thoracic surgeons should therefore avoid such procedures if possible<sup>1)</sup>. With minimal invasiveness, VATS is useful in the diagnosis of lesions of the pleura, the lung parenchyma, and the mediastinum<sup>4,5)</sup>. VATS has advantages over open thoracotomy in terms of postoperative complication such as chest pain. Although in this study, there was no significant difference in the incidence after the introduction of VATS, exploratory thoracotomy was avoided in 5 cases by using VATS.

Pleural dissemination and/or pm was the most common reason for nonresectability with an incidence of 38.3%

in our series and 30% in the report by Hara *et al.*<sup>2)</sup> Our 5 patients for whom exploratory thoracotomy was avoided by using VATS showed evidence of pleural dissemination and/or pm. The criteria for resection of lung carcinoma vary from institution to institution. Martini *et al.*<sup>6)</sup> performed pleurectomies on 41 patients with malignant effusion due to lung carcinoma. Twenty-three percent of these cases were alive at 12 months after the operation, but mean survival time (MST) was 6 months with a surgical mortality rate of 10%. We think that a patient with pleural dissemination is not a candidate for operation because even in exploratory thoracotomy cases, MST was 10 months in our series. The case with intrapulmonary metastasis (pm) was classified in stage IV with 7.5% 5-year survival rate<sup>7)</sup>. Naruke *et al.*<sup>7)</sup> reported 89 primary lung cancer patients with pm in one lobe, 57 with pm in more than two lobes, and they noted that 5 of the 89 patients with pm in one lobe survived 5 years after the operation, while 3 of the 57 with pm in more than two lobes survived 5 years after the operation. Deslauriers *et al.*<sup>8)</sup> evaluated satellite nodules as a factor influencing prognosis after resection of lung carcinoma. Satellite nodules may be defined as well-circumscribed accessory carcinoma foci clearly separated from the main tumor but with identical histologic characteristics. They proposed that this group should be included in stage IIIA. In our series, 4 patients in whom exploratory thoracotomy was avoided because of pm had metastases in 2 to 3 lobes; therefore, we considered such tumors to be nonresectable. Some patients with pm and/or pleural dissemination may benefit from surgical resection; however, such patients may be very few.

Another common reason for nonresectability was bulky N2 disease with 30% to 60% incidence at the institutions where mediastinoscopy is not employed<sup>1, 2, 9, 10)</sup>. It is however, impossible to provide clear guidelines for the management of patients with technically resectable primary lung carcinoma that has spread to mediastinal lymph nodes<sup>11)</sup>. Although left-sided N2 metastases of the aortic arch cannot be investigated with mediastinoscopy, these lymph nodes can be inspected and biopsied with VATS. We will be able to reduce the incidence of exploratory thoracotomy in bulky N2 disease with VATS, although we could not avoid exploratory thoracotomy in bulky N2 cases (case 6 and 7) in these initial experiences.

Recently, Roviario and his colleagues<sup>12)</sup> reported routine use of VATS for staging and surgical treatment of lung carcinoma. Using VATS on 155 patients, 13 were found to have nonresectable tumors, 10 patients preoperatively unexpected and 3 suspected. Again, using VATS, nonresectability was determined in 7 cases showing pleural dissemination without effusion. Although Roviario *et al.* used VATS routinely for staging, we performed VATS on marginal candidates for thoracotomy after preoperative evaluation. Routine VATS procedure is a waste of money and time-consuming. Although we failed to determine nonresectability in patients with aortic invasion,

Roviario *et al.*<sup>12)</sup> reported that VATS allowed for determination of nonresectability due to the mediastinal invasion in 4 cases and the esophageal invasion in 1 case. We think it is controversial that the VATS procedure can determine resectability of suspected mediastinal invasion.

We conclude that VATS may be the procedure of choice to avoid exploratory thoracotomy for lung cancer in marginal candidates, particularly when pm and/or pleural dissemination is suspected.

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