Original Article

Lobectomy by Video-assisted Thoracic Surgery for Lung Cancer Patients Aged 80 Years or More

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To clarify the usefulness of video-assisted lobectomy for lung cancer patient aged 80 years old or more, a retrospective study was conducted to evaluate the clinical outcome. Between 1982 and 2001, 914 patients underwent surgery for primary lung cancer at the Nippon Medical School Hospital. Among them, 32 patients underwent lobectomy, including 17 with a mean age of 82 years (range, 80 to 91 years) who underwent video-assisted lobectomy and 15 with a mean age of 82 years (range, 80 to 86 years) who underwent lobectomy by standard thoracotomy. Of these 32 patients, clinical outcome was evaluated retrospectively. Mortality was 4 (12.5%) of 32 patients consisting of 3 (20%) of 15 who underwent lobectomy by standard thoracotomy and 1 (5.9%) of 17 who underwent video-assisted lobectomy. Single variate analyses revealed that the presence of preoperative cardiopulmonary disease, 0.6 L or more of predicted postoperative forced expiratory volume in one second/m^2, 700 ml or more of blood loss, five hours or more of duration of operation and two or more of postoperative complications were considered as risk factors regarding mortality within three months postoperation. Among the patients who underwent lobectomy with mediastinal lymph node dissection, the 5-year survival rate at stage I (IA+IB) was 55.6% for patients who underwent video-assisted lobectomy and 0% for patients who underwent lobectomy by standard thoracotomy (IA=2, IB=2). Video-assisted lobectomy for lung cancer patients aged 80 years or more is considered to offer an acceptable clinical outcome. However, further observation on prognosis is necessary. (Ann Thorac Cardiovasc Surg 2003; 9: 14–21)

Key words: lung cancer, aged patients, video-assisted lobectomy

Introduction

In 1999, the statistical analysis on annual change in life expectancy by Japanese Health and Welfare section stated that 7.53 years for males and 10.18 years for females were expected for 80-year olds on as duration of life expectancy, respectively. With the increase in the population of elderly people, the surgical approach to lung cancer patient aged 80 years or more has become popular.[1-8] According to these results, risk of surgery was considered to depend not on age but on the patient's condition.[2-8] In the last ten years, several authors have emphasized the efficacy of video-assisted thoracic surgery (VATS) lobectomy.[9-15] However, unresolved problems still remain. We have performed 692 thoracoscopic surgeries at Nippon Medical School Hospital between October 1994 and December 2001, and VATS lobectomy in 115 patients including 98 elderly patients with peripheral lung cancer, indicative of the increase in the elderly population in Japan. Of these, 17 patients aged 80 years or more underwent VATS lobectomy for primary lung cancer, in expectation of preservation of physiologic reserve because of

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Received June 17, 2002; accepted for publication November 21, 2002.
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Table 1. Patients demographics

	Group	VATS (n=17)	ST (n=15)	Statistics	P value
Age	(years)	82 (80-91)	82 (80-86)	NS	0.68
Gender	(male/female)	13/4	11/4	NS	0.83
Performance status (PS)	0/1/2	6/10/1	7/8/0	NS	0.57
Brinkmann index		1032±725	1079±1058	NS	0.89

There were no significant differences in age range, gender, preoperative performance status and smoking index between two groups.
ST, lobectomy by standard thoracotomy; VATS, video-assisted lobectomy

it being minimally invasive. This retrospective study revealed that VATS lobectomy with mediastinal lymphadenectomy was feasible for this age group with minimal deterioration of performance status and longevity of prognosis compared with those of the same age group who underwent ST lobectomy. Therefore, we reviewed the results regarding advantages or disadvantages of VATS lobectomy for patients aged 80 years or more with primary lung cancer.

Patients and Methods

Patients' demographics in this study (Table 1)

From June 1982 to December 2001, 914 patients underwent pulmonary resection for primary lung cancer at the Nippon Medical School Hospital. Among them, 115 patients underwent VATS lobectomy. Thirty-two of 115 patients underwent lobectomy, including 17 with a mean age of 82 years (range, 80 to 91 years) who underwent VATS lobectomy and 15 with a mean age of 82 years (range, 80 to 86 years) who underwent ST lobectomy for peripheral lung cancer. There were 13 males and 4 females who underwent VATS lobectomy and 11 males and 4 females, ST lobectomy. Stage demographics were described according to the TNM classification revised in 1997. Of these 32 patients, clinical outcome was evaluated retrospectively. Two physicians evaluated changes in performance status before the operation and three months after surgery at an outpatient clinic.

Surgical technique

Pulmonary lobectomy was performed under general anesthesia using one-lung ventilation with the patients in the decubitus position. In VATS lobectomy, one minithoracotomy and two ports were employed. A third port was utilized when further thoracoscopic observation was required during mediastinal lymph node dissection. A 1.0- to 2.0-cm-long skin incision was made at the sixth intercostal space of the anterior axillary line as the first trocar hole for observation of the pleural cavity with a 10-mm-diameter or 5-mm-diameter thoracoscope. Then, a 7-cm-long skin incision on average (range 4-10 cm) was made for minithoracotomy without dissection of the muscle layer and resection of the rib. A minithoracotomy was made in the fourth intercostal space of the anterior axillary line in patients who underwent upper lobectomy or right middle lobectomy, and in the fifth or sixth intercostal space of the posterior axillary line around the triangle of auscultation in patients who underwent lower lobectomy of both lungs. The second port was made in the eighth intercostal space of the posterior axillary line and the third port was made in the third intercostal space of the midaxillary line, if a wider thoracoscopic view was needed during mediastinal lymphadenectomy. The mediastinal pleurae were dissected using an endoscopic electrocautery or ultrasonic dissector (Ethicon Endo-Surgery Inc., Cincinnati, OH, USA and U.S. Surgical Corp., Philadelphia, PA, USA). Pulmonary arteries and veins were divided for ligation and/or endoscopic stapling. Ligation was performed using a knot pusher (Ethicon Endo-Surgery Inc.). Transection of the bronchus was carried out using an endoscopic stapler (Ethicon Endo-Surgery Inc. and U.S. Surgical Corp.). Adhesiotomy, pleural dissection and mediastinal lymphadenectomy were performed using an endoscopic electrocautery and/or ultrasonic dissector. A resected pulmonary lobe was removed from the thorax using a plastic retrieving bag so as not to contaminate the surrounding tissues. An ST lobectomy was performed with a 25-cm-long posterolateral thoracotomy with separation of the muscle layer and partial resection of the fifth rib in order to obtain a good view and sufficient working space. Mediastinal lymphadenectomy was performed in 12 cases of VATS lobectomy and seven cases of ST lobectomy. Regional lymphadenectomy was performed in four cases of VATS lobectomy and five cases of ST lobectomy.

Table 2. Preoperative concomitant diseases

Number of patients	VATS (n=17)	ST (n=15)	Statistics	P value
Concomitant disease (none/present)	(1/16)	(2/13)	NS	0.47
Incidense of concomitant diseases	n=53	n=23	Significant	0.001
Respiratory diseases	13	9	NS	0.24
COPD	4	7		
Interstitial pneumonia	3	1		
Pulmonary tuberculosis	6	1		
Cardiovascular diseases	22	8	Significant	0.02
Arrhythmia	6	2		
Ischemic heart disease	4	2		
Valvar disease	2	0		
Hypertension	10	4		
Cerebrovascular diseases	5	0	NS	0.1
Postoperation for other organs*	7	3	NS	0.07
Metabolic diseases	6	3	NS	0.33
Diabetes mellitus	1	2		
Liver dysfunction	1	0		
CRF under hemodialysis	4	0		

Incidence of preoperative concomitant diseases is frequent in VATS lobectomy patients, particularly in cardiovascular disease. COPD, chronic obstructive pulmonary disease; CRF, chronic renal failure. *: colon cancer, gastric cancer, urinary bladder cancer, hypopharyngeal cancer, thoracoplasty, gastric ulcer and choledocholitiasis

Statistical analyses

Analyses were performed using the software package of Stat View 5.0 (SAS Inc., Chicago, IL, USA). The chi-square test was used to analyze nominal data. The mean values with exception of performance status were compared using paired Student's t-test for paired data and for two independent variables. Since the data obtained in performance status was not normally distributed, the Mann-Whitney rank sum test was performed to analyze it. Multivariate logistic regression analysis was used according to the forward stepping method in terms of testing the relationship of mortality within three months postoperation to perioperative patients' conditions. The survival rate was statistically analyzed using the Kaplan-Meier estimated survival curves, and the significance of the difference was analyzed by the log-rank test. A p value of less than 0.05 was considered significant.

Results

Preoperative conditions (Table 2)

Sixteen of 17 (94%) VATS lobectomy patients and 13 of 15 (87%) ST lobectomy patients had various preoperative concomitant diseases, including 3.3±1.6 events per patient in VATS lobectomy patients and 3.3±1.6 events per patient in ST lobectomy patients ($p<0.001$). Serious concomitant diseases were observed in VATS lobectomy patients, which is because VATS lobectomy was indicated for patients with poor physical reserve since October 1994. Preoperative concomitant diseases frequently observed were cardiovascular diseases and respiratory diseases. Preoperative cardiovascular diseases were observed in 0.6±0.7 events per patient in ST lobectomy patients and 1.2±0.9 events per patient who underwent VATS lobectomy. Pulmonary concomitant disease was observed in 0.5±0.6 events per patient in ST lobectomy patients and 0.8±0.7 events per patient who underwent VATS lobectomy, preoperatively. Other concomitant diseases were cerebral infarction, renal insufficiency under hemodialysis, diabetes mellitus and history of surgery for other organ diseases. Preoperative pulmonary function test results are as follows: %VC, 99±12% in VATS lobectomy patients and 97±15% in ST lobectomy patients; $FEV_{1.0}$ (%), 64±10% and 59±14%; $FEV_{1.0}/M^2$, 1.17±0.27 L/M^2 and 1.11±0.55 L/M^2, respectively. There were no significant differences between the two groups.

Operative and perioperative conditions (Table 3)

Duration of operation tended to be longer in the case of VATS lobectomy than that of ST lobectomy. The amount of blood loss ($p=0.028$) and maximal serum creatinine phosphokinase level (max. CPK $U/L/M^2$) ($p=0.004$) as a

Table 3. Surgery and pathological finding

	Group	VATS (n=17)	ST (n=15)	Statistics	P value
Surgery					
Operation side	Right/left	10/7	11/4	NS	0.38
Resected lobe	RUL	2	4		
	RML	1	2		
	RLL	7	4	NS	0.59
	LUL	6	3		
	LLL	1	1		
	RUM	0	1		
Lymphadenectomy	(ND2a/ND1)	12/5	6/9	NS	0.52
Duration of operation	(min)	293±86	272±67	NS	0.46
Blood loss	(ml)	312±227	707±628	Significant	0.02
Postoperative conditions					
Duration of chest drainage	(day)	5±2	7±4	NS	0.06
Max. CPK	(U/L/M^2)	520±260	904±523	Significant	0.004
Postoperative length of hospitalization	(day)	19±7	29±19	NS	0.29
Changes in performance status=(pre-post)	–3/–2/–1/0/+3	1/0/1/15/0	2/2/7/3/1	Significant	0.004
Histopathological examination					
Histological type	Sq/Ad/Sm	7/10/0	5/9/1	NS	0.53
Pathological stage	I (A/B)	14 (3/11)	8 (3/5)		
	II (A/B)	1 (1/0)	3 (0/3)	NS	0.14
	III (A/B)	2 (1/1)	4 (4/–)		
Pathological “t” factor	t1/t2/t3	3/14/0	3/11/1	NS	0.53
Pathological “n” factor	n0/n1/n2	14/2/1	8/3/4	NS	0.17

There were significant differences in amount of blood loss, maximal serum CPK and change in performance status between the two groups.

ST, lobectomy by standard thoracotomy; VATS, lobectomy by video-assisted thoracic surgery; RUL, right upper lobectomy; RML, right middle lobectomy; RLL, right lower lobectomy; LUL, left upper lobectomy; LLL, left lower lobectomy; Sq, squalors cell carcinoma; Ad, adenocarcinoma; Sm, small cell carcinoma; Max. CPK, maximal serum creatinine phosphokinase

parameter of chest damage was minimal in VATS lobectomy patients in comparison with those in ST lobectomy patients. Ten ST lobectomy patients suffered from 17 postoperative complications and eight VATS lobectomy patients suffered from 14 postoperative complications (Table 4). Postoperative bleeding and persistent air leakage for more than seven days were observed in both groups. One patient in each group required additional surgery to stop bleeding after adhesiotomy. The multivariate logistic regression test on preoperative conditions concerning two or more of postoperative complications indicated that the presence of preoperative concomitant disease was considered to be a risk factor in both VATS and ST lobectomy patients (Table 5). A single variate analysis for 3-months postoperative mortality was performed (Table 6). The presence of preoperative pulmonary disease, less than 1.0 L of preoperative $FEV_{1.0}$, less than 0.6 L of predicted postoperative $FEV_{1.0}/M^2$, 55% or less of predicted postoperative %VC and/or $\%FEV_{1.0}$, 700 ml or more of blood loss, five hours or more of duration of operation and two or more of postoperative complications were considered to be risk factors for 3-months postoperative mortality. Mortality within 30 days or during the same hospitalization period was 5.9% (1/17) in the case of VATS lobectomy and 20% (3/15) in that of ST lobectomy. One patient who underwent a VATS lobectomy died after recurrence of a major cerebral infarction on the 13th postoperative day and three patients who underwent ST lobectomy died of pneumonia on the 35th, the 7th and the 34th postoperative day. Three of four patients were suffering from pulmonary fibrosis and chronic bronchitis preoperatively and were predicted to have poor postoperative $FEV_{1.0}/M^2$ of 0.45 L, 0.5 L and 0.6 L respectively (Table 7).

Survival rate

The patients who underwent a lobectomy were followed-up for a period of 6 months to 80 months with a mean follow-up period of 30 months through their regular visits to the outpatient clinic, mail or telephone contact with patients, relatives or attending physicians. All patients who underwent lobectomy with mediastinal lymphadenectomy

Table 4. Postoperative complications

Number of patients	VATS (n=17)	ST (n=15)	Statistics	P value
Concomitant (none/present)	(9/8)	(5/10)	NS	0.26
Incidense of complications	n=14	n=17	NS	0.34
Respiratory diseases	5	7	NS	0.4
Air leak>7 days	2	3		
Atelectasis	0	2		
Pneumonia	2	1		
Bleeding	1	1		
Cardiovascular diseases	5	6	NS	0.54
Arrhythmia	5	6		
Cerebrovascular disease	1	0	NS	0.33
Respirator>2 days	2	2	NS	0.89
Others	1	2	NS	0.35
Delirium	1	1		
Recurrent nerve palsy	0	1		

There were no significant differences in incidence of postoperative complications between the two groups.
ST, lobectomy by standard thoracotomy; VATS, lobectomy by video-assisted thoracic surgery

Table 5. Multivariate logistic regression analyses on preoperative conditions with respect to two or more of postoperative complications

Variable	Odds ratio	95% CI	P value
Brinkmann index (≥1000, <1000)	11.13	0.9-124.4	0.05
Preoperative concomitant disease (present, none)	8.04	1.08-59.89	0.04

Severe smoking history and the presence of preoperative concomitant disease were considered to be risk factors for the course of postoperative complications.

(ND2a) showed the 1-, 3-, 5-year survival rate to be 91.7%, 69.8%, 46.6% in VATS lobectomy patients and 66.7%, 50%, 16.7% in ST lobectomy patients, respectively. In the case of VATS lobectomy patients who underwent mediastinal lymphadenectomy (ND2a) at stage I (n=9; IA=1, IB=8), the 1-, 3- and 5-year survival rate were 100%, 83.3% and 55.6%, respectively (Fig. 1). In the case of ST lobectomy patients at stage I (n=4; IA=2, IB=2), the 1-, 3- and 5-year survival rate were 100%, 66% and 0%, respectively. In the patients at stage IIA or more, the 1-, 2-year survival rate were 66.7%, 33.3% in VATS lobectomy patients (n=3; IIA=0, IIB=1, IIIA=1, IIIB=1) and 40%, 0% ST lobectomy patients (n=5; IIA=0, IIB=1, IIIA=4).

Table 6. Single variate analyses on mortality within 3 months postoperation

	P value
Preooperative pulmonary diseases (none or present)	0.04
Preoperative $FEV_{1.0}$ (≥1.0 L, <1.0 L)	0.002
ppO $FEV_{1.0}$/M2 (>0.6 L, ≤0.6 L)	0.002
ppO %VC and/or ppO $\%FEV_{1.0}$ (≥56%, <55%)	0.006
Blood loss (≥700 ml, <700 ml)	0.04
Duration of operation (≥5 hours, < 5 hours)	<0.001
Postoperative complications≥2 events	<0.001

Factors concerning mortality within 3 months postoperation were the presence of preoperative pulmonary disease, poor pulmonary function, large amount of blood loss, long surgery and postoperative complications.
ppO %VC, predicted postoperative % vital capacity; ppO $\%FEV_{1.0}$, predicted postoperative % forced expiratory volume in one second

Discussion

The statistical analysis on annual change in life expectancy by Japanese Health and Welfare section revealed that 7.53 years for male and 10.18 years for female were expected as duration of life expectancy for 80-year olds in 1999, respectively. Currently, greater experience of sur-

Table 7. Mortality within 30 days or during the same hospitalization period

No.	Age	Gender	Preoperative concomitant disease	ppO %$FEV_{1.0}$ (ppO $FEV_{1.0}/M^2$)	p-tnm	Operation	Cause of death Period (days)
1	82	Female	Pulmonary emphysema	43%	t3n2m0	ST	Pneumonia
			Chronic bronchitis	(0.45 L)	t3=p3 (pleura)	LLL+ND2	35 days
2	83	Male	Renal insufficiency	47%	t2n0m0	ST	Pneumonia
			Bronchial asthma	(0.5 L)		RLL+ND0	7 days
3	80	Male	Chronic bronchitis	83%	t3n2m0	ST	Pneumonia
				(0.95 L)	t3=p3 (pleura)	RUM+ND2a	34 days
4	83	Male	Cerebral infarction with hemiplegia	50%	t4n0m0	VATS	Brain infarction
			Pulmonary fibrosis	(0.6 L)	t4=PMl	LLL+ND0	13 days

Patients died within 30 days or during the same hospitalization period: One VATS lobectomy patient and three ST lobectomy patients died within 30 days or during the same hospitalization period.
PM, intrapulmonary metastasis; ppO %$FEV_{1.0}/M^2$, predicted postoperative % forced expiratory volume in one second/M^2

gery for elderly lung cancer patients has been reported with the increase in the population of elderly people world wide.[1-8] In 1983, a large-scale investigation by Ginsberg et al.[1] mentioned a high mortality rate among patients aging 70 years or more following a major pulmonary resection by standard thoracotomy. They reported that the mortality rate was particularly high among patients aged 80 years old or more (8.1% of 37 patients) who underwent standard thoracotomy. Despite this observation, from around 1980, several authors recommended surgery, even lobectomy, for patients aged 80 years old or more with primary lung cancer, when the mental and physical conditions of a patient were adequate for surgical intervention.[1-8] According to these results, the operative mortality was 13.3% on average, ranging from 3.7% to 21%, among ST lobectomy patients (Table 8). Therefore, clinical outcome of patients who underwent VATS lobectomy was compared to those of patients who underwent ST lobectomy, as a historical control. In the present study, the mortality rate among patients following ST lobectomy was 20% (3/15), which is higher than the above-mentioned average of 13.3%. In contrast, that was 5.9% (1/17) in patients who underwent VATS lobectomy. Even though the postoperative mortality rate among patients aged 80 years old or more who underwent VATS lobectomy seemed to be acceptable, a perioperative complication is still a life-threatening problem. Prior study revealed operation duration as an independent risk factor as for morbidity and operative procedure (VATS or ST) as for deterioration of performance status.[15] The single analysis on perioperative conditions suggests the superiority of VATS lobectomy in terms of a small amount of blood loss, short period of chest drainage and low level of maximal serum CPK U/L/M^2 postoperation as a parameter of chest wall damage. The multivariate analysis suggests that the long duration of surgery affected the postoperative course of patients. Furthermore, though VATS lobectomy patients had a low incidence of postoperative complica-

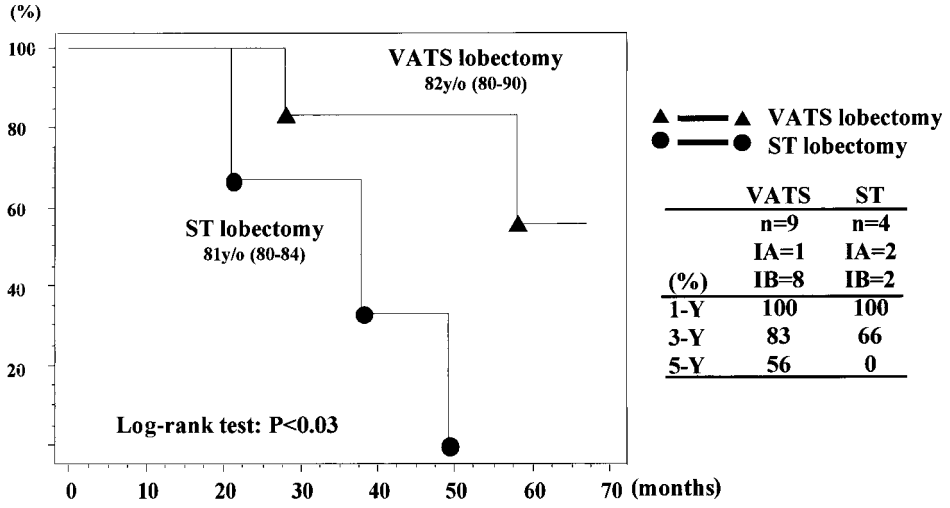

Fig. 1. Survival curves of patients at stage I (IA+IB who underwent VATS lobectomy with mediastinal lymph node dissection (ND2a) (circles) and those who underwent ST lobectomy (triangles) with ND2a. There were no significant differences in age range or pathologic stage between the two groups. VATS lobectomy patients showed a favorable prognosis compared to that in ST lobectomy patients.
VATS; lobectomy by video-assisted thoracic surgery; ST, lobectomy by standard thoracotomy

Table 8. Review of pulmonary resection in aged lung cancer patients

Authors	Year	Period (years)	Procedure VATS or ST	No. of resections	Operative mortality (%)	5-year survival rate for Stage I (%)
Ginsberg et al.[1]	1983	3 (1979-81)	ST	37	8.1	NS
Shirakusa et al.[2]	1989	10 (1978-87)	ST	33	13	79
Naunheim et al.[3]	1994	10 (1981-91)	ST	37	16	NS
Riquet et al.[4]	1994	6 (1984-90)	ST	11	12.1	NS
Osaki et al.[5]	1994	17 (1974-91)	ST	31	21	38
Harvey et al.[6]	1995	9 (1985-94)	ST	17	17.6	NS
Pagni et al.[7]	1997	16 (1980-95)	ST	54	3.7	57
Sioris et al.[8]	1999	20 (1976-96)	ST	13	15	32
McKenna et al.[14]	1998	5 (1992-97)	VATS	12	16	70*
Koizumi et al.	present study	6 (1994-2001)	VATS	17	5.9	56

VATS, lobectomy by video-assisted thoracic surgery; ST, lobectomy by standard thoracotomy; NS, not stated. *: mean age=68

tions compared to those in ST lobectomy patients, the same types of postoperative complications were observed for both surgical procedures. Among the postoperative complications, cardiac events such as atrial fibrillation was the most frequent, occurring within a few postoperative days, which was well managed pharmacologically. In contrast, the most common cause of postoperative death in this series was pneumonia resulting from poor postoperative pulmonary function as reported by Shirakusa et al.[2] and Haraguchi et al.[17] Atelectasis and persistent air leak sometimes tended to cause not only cardiopulmonary complications but also other lethal complications postoperatively. Therefore, surgeons must avoid such complications either in ST lobectomy or in VATS lobectomy. Furthermore, thoracic surgeons have pursued refinement of anesthesia, surgical procedures and perioperative intensive care.[16,17] DeCamp et al.[9] analyzed prospectively 895 videoscopic procedures in 1995, and Jaklitsch et al.[10] reviewed 307 patients aged 65 to 89 years focusing on 33 patients aged 80 to 89 years in 1996. Three of the 33 patients underwent lobectomy or segmentectomy without resulting in death. Based on this achievement, in 1999, Jaklitsch et al.[12] recommended that with the availability of new surgical options for elderly lung cancer patients, age alone should not be a contraindication for thoracic surgical interventions with video thoracoscopy carefully applied.

Concerning the curability of lung cancer by VATS procedure, it is still controversial whether VATS lobectomy with mediastinal lymph node dissection (ND2a) is a curative surgery, even though VATS lobectomy offers several advantages. Though Kirby et al.[18] suggested the evidence of the potential short-term benefit in VATS lobectomy compared to that in muscle-sparing thoracotomy, they emphasized what is important in the surgical treatment of lung cancer. Their issue seems to be a warning on the proper purpose of minimally invasive surgery or of lung cancer surgery. Landreneau et al.[19] in 1997 recommended that because of the increased risk for local recurrence following surgical treatment for lung cancer, anatomic lobectomy remains the surgical treatment of choice for patients with stage I nonsmall-cell lung cancer and who have adequate physiologic reserve. As for the safety of VATS lobectomy, McKenna et al.[14] reported in 1998 that VATS lobectomy for lung cancer appears to be a safe procedure, with the same survival rate as that expected for a lobectomy performed with standard thoracotomy. Kaseda et al.[11] reviewed the safety of VATS lobectomy with mediastinal lymphadenectomy in 1997.

The reported 5-year survival rates among octogenarians who underwent ST lobectomy were 51.5% on average (32-79%). (Table 6) In the present study, the survival rate in VATS lobectomy patients seemed to be better than that in ST lobectomy patients. However, it remains unknown which factor might offer an advantage in the prognosis for patients at stages IA and IB who underwent VATS lobectomy. Further follow-up and investigation should be required to clarify this issue.

The quality of life after surgery must be a very important matter for patients aged 80 years or more. If marked deterioration in quality of life were expected after surgery, patients would refuse to undergo surgery. We reported effectiveness in change between the pre- and postoperative performance status in elderly lung cancer patients who underwent VATS lobectomy.[13,15] Even though the number of patients studied is small, we considered VATS lobectomy might be a profitable treatment for aged lung cancer patients as for longevity of daily life activi-

ties and survival rate.

Conclusion

Even though the number of patients studied is small in this study and several problems existed, VATS lobectomy for aged lung cancer patients might be a beneficial surgical treatment in terms of postoperative outcome. Further follow-up and investigations are required to clarify these problems.

Acknowledgments

The authors thank Nobuo Hatori, MD, PhD for cooperation on statistical analysis of the results in the present study.

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