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Video-assisted Thoracic Surgery (VATS) Lobectomy: Chest Disease Institute Experience

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Abstract

Background: **Improvements in surgical equipment have rendered video-assisted thoracic surgery (VATS) an effective means for thoracic surgeons. Nowadays several intrathoracic diseases can benefit from this approach. This development has expanded potential use and recently the technical feasibility of major lung resections by VATS has been demonstrated. The purpose of this report is to review our experience of VATS lobectomy.**

Materials and Methods: **From January 2001 to December 2005 we proposed VATS for major pulmonary resections with the following indications: benign lung lesions, solitary pulmonary mass and established stage 1-2 non-small cell lung cancer (NSCLC).**

Results: **Of 47 patients, we successfully performed VATS procedure in 38 cases. Final diagnoses included 27 primary lung cancers, one metastatic lung cancer, 5 bronchiectases, 2 tuberculoses, one cryptococcosis, one actinomycosis and one pulmonary sequestration. While in another 9 patients (19.1%) a conversion to conventional thoracotomy was required. There were 33 lobectomies, 4 bilobectomies and one pneumonectomy. In all unproved benign lesions, radical lymphadenectomy was performed. There was no mortality. The major complication is prolonged air leak which occurred in 5 patients (13%).**

Conclusion: **We believed that VATS in pulmonary lobectomy is a safe and effective approach. It has several benefits over standard thoracotomy other than smaller incision.**

Key words: **video-assisted thoracic surgery, pulmonary lobectomy**

Introduction

Since its introduction in 1910, thoracoscopy has been a valuable surgical means for the investigation of pleural diseases or the diagnosis of intrathoracic malignancy. Lewis,[1] in 1992 reported the first thoracoscopic lobectomy with the use of standard instruments, a small incision and a thoracoscope for visualization. This report initiated our experience with video-assisted thoracic surgery (VATS) lobectomy for both benign and malignant lung lesion.

This study was undertaken to evaluate the morbidity, mortality and feasibility in performing a complete lobectomy as well as radical node dissection in the same manner as conventional thoracotomy with thoracoscopy and modified simple instruments.

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Materials and Methods

Between January 2001 and December 2005, a total of 47 patients underwent VATS lobectomy with mediastinal lymph node dissection (in the case of suspicious lung cancer) at Chest Disease Institute. Nine patients (19.1%) were converted to conventional thoracotomy due to pleural adhesion (8 patients), incomplete lung fissure (2 patients) and bleeding (1 patient). As a result, 38 patients (80.4%) successfully underwent VATS lobectomy. There were 18 males and 20 females with the mean age of 53.5 years. Patient characteristics were shown in Table 1.

Clinical evaluation included chest roentgenogram, computed tomography (CT) scan of the chest and upper abdomen and pulmonary function test. The criteria for thoracoscopic lobectomy are the same as lobectomy using the open approach, patients with known or suspected lung cancer that appear amenable to complete resection by lobectomy. All patients were judged to have clinical stage 1 or 2 Non-Small Cell Lung Cancer (NSCLC)[2] without evidence of chest wall invasion,[3] mediastinal lymphadenopathy,[3] prior thoracic irradiation,[4] central hilar lesion,[5] atelectasis,[6] endobronchial tumor seen at bronchoscopy,[3,5,6] calcific bronchi[7] and lesion crossing a fissure.[7] Tumor size should be less than 5 cm.[3] However, there was no absolute tumor size criteria and one of our patients' mass was 5 × 9 cm. in size.

Table 1 Patient Characteristics

Characteristics	
Age, yr (mean)	22-72 (53.5)
Sex	
Male	18
Female	20
Lobectomy site	
RUL	8
RLL	11
RML	1
RLL+RML	3
RUL+RML	1
LUL	6
LLL	7
Rt pneumonectomy	1
Tumor size, cm (mean)	1-9 (2.8)
Operating time, minutes (mean)	120-330 (233.7)
Bleeding, ml (mean)	100-2900 (659.5)
Duration of thoracic drainage, days (mean)	2-39 (8.3)

All procedures were performed while the patient was under general anesthesia with a double lumen endotrachial tube. With the patient in the lateral decubitus position, the rigid zero degree thoracoscope was passed through a 12 mm. trocar in the eighth intercostal space, midaxillary line. Additional one or two further access ports were created in varying locations for traction and countertraction. A skin incision, 5 to 6 cm long, was made on the midaxillary line except in 2 cases where the incision was made along anterolateral chest.[8] The chest cavity was entered through the fifth intercostal space which was opened to a width of about 2 cm using a thoracic opener. The surgeons usually divided the pulmonary vessels and bronchus under direct vision via minithoracotomy site, aided by an assistant via the other ports. All pulmonary vessels were ligated with silk. Bronchial division was done by Linear Stapler 30 mm Ethicon. Mediastinal nodes were routinely dissected completely in cases where malignant lesion could not be excluded. The chest was drained with two straight 28 F chest tubes through previous access ports.

Results

Forty-six patients were initially accepted as potential candidates for VATS lobectomy. In 9 patients the procedure was converted to a formal thoracotomy (Table 2) due to dense pleural adhesion (8), largely fused fissure lung (2) and bleeding (1) or the combination. In the remaining 38 patients, a VATS lobectomy or pneumonectomy was successfully accomplished. There was no mortality. Other than prolonged air leak, there was no other morbidity in our study. The mean operating time was 236.4 minutes and the average blood loss was 672 ml. Chest tube drainage was required for a mean of 8.3 days with 5 instances of a prolonged air leak for more than 14 days, all of which resolved with conservative management.

Table 2 Causes of failed VATS in 9 patients

Reasons for conversion to thoracotomy	Number of patients
Pleural adhesion	8
Largely fused fissure lung	2
Bleeding	1

Table 3 Pathological report

Postoperative Histology	Numbers
Bronchiectasis	5
Tuberculosis	2
Cryptococcosis	1
Actinomycosis	1
Pulmonary Sequestration	1
Metastatic Carcinoma	1
Bronchogenic Carcinoma	27
Adenocarcinoma	12
Bronchoalveolar Carcinoma	7
Adenosquamous Cell Carcinoma	3
Squamous Cell Carcinoma	3
Small Cell Carcinoma	1
Carcinoid Tumor	1

Table 4 Final pathological staging in 27 patients with Bronchogenic Carcinoma

Stage of resected tumor	Numbers
Stage 1	
T1N0	4
T2N0	7
Stage 2	
T1N1	4
T2N1	4
Stage 3	
T1N2	4
T2N2	4

Preoperatively, malignancies were suspected or confirmed in 31 patients, however, the final diagnosis were benign disease in 9 patients (Table 3). Among the cases of primary lung cancer, 11 out of 27 patients were in stage 1, while 8 patients were in stage 2 and the other 8 patients were in stage 3 (Table 4).

Discussion

The possibility of carrying out a major VATS lung resection in selected cases has been described since the 1990s,[9,10] but only few centers worldwide perform this operation routinely.[6] It remains controversial because surgeons have been concerned about the safety of this procedure and the adequacy of cancer operation when it is performed for lung cancer.[8,11] It is undoubtedly more technically demanding than conventional procedure. At present some randomized studies[12-19] had proven the advantages of VATS lobectomy over standard lobectomy. In contrast, few randomized studies[20,21] revealed that VATS did not offer any advantages. The benefits of VATS appear to include reduced postoperative pain,[12-15,17,22-29] improved post operative pulmonary function,[12,17,18,29] reduced chest tube duration[15] and hospital stay,[13,15,28,31] less blood loss,[13,28,32] faster resumption of regular activities,[14,15,26] less complication regarding prolonged air leak[20,27] and improved cosmetic result.[14] Yim[8] claimed to have lesser mortality with VATS lobectomy (0-2%) than standard lobectomy (4-6%). However, both figures were based on different time frame and not from a randomized study. Some reports showed no difference in operating time,[19,20,28,29] blood loss,[20,21,29] chest tube duration,[13,20,21,29,33] and length of stay.[20,33] On the other hand, some reported longer operating time in VATS group.[13,32]

There are various reasons as to why our procedure of VATS lobectomy required more operating time with more blood loss than the conventional thoracotomy. Firstly, we are still on the learning curve. We tried to use conventional instruments such as silk ligation for pulmonary vessels instead of endo-GIA stapler, and Linear stapler (Figure 1) for bronchial division instead of endo-GIA stapler (Figure 2) which was 4 times more expensive. Secondly, our largest tumor size was 5 × 9 cm., same as reported by Lewis et al[50] and not just 3-4 cm in diameter as in most literatures.[5,6,21,34-49] Larger tumor causes more difficulties in the operation. Third and lastly, we routinely performed radical mediastinal node removal in the case of suspected lung cancer which was more difficult to perform compared to open thoracotomy. In most of western

Fig. 1 Linear stapler

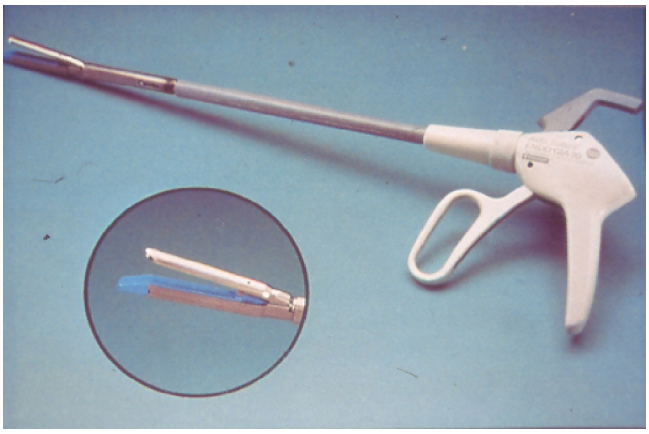

Fig. 2 Endo GIA stapler

reports,[2,3,5-7,11,15,19,33,46,52] node sampling was performed, while in most reports from Japan[13,16,29,34-38,51] similar procedure to our was performed. We practiced on the principal that our procedure yielded identical results as through a major thoracotomy.

We had no different results in chest tube duration and length of stay when compared to our open lobectomy since most of our technique and instruments were similar to standard thoracotomy except for a smaller incision and the narrow rib spreading. We had to convert from VATS to thoracotomy in 9 patients (19.1%). Gharagozloo et al[5] reported no conversion among 179 patients. Others[2,3,6,21,33,39,41,48,52-61] had conversion rate ranged from 2.5-27% with mean of 13.2% (Table 5). However, we had no conversion in our last 10 cases. Moreover, a conversion rate of 20% is generally accepted.[62]

Most reports including ours had no mortality rate mainly because of the patient selection and the number of patients was not large enough. The major complication in our study was prolonged air leak for more than 14 days in 5 patients (13%). Fortunately, all resolved without reoperation. This is also the most common complication in other series.[3,5,20] Other complications reported from other series included perioperative pneumonia,[3,5] prolonged ventilation,[5,56,60,63] pulmonary infarction, [5,60] bronchopleural fistula,[56,60,63] wound infection[5] and postoperative myocardial infarction.[5]

Ten patients (26.3%) in this study had benign diseases, other series[34-36,50,52,61] showed that 3-22% (mean 13.7%) had benign diseases. However, Weber et al[64] reported VATS lobectomy for benign disease in 64 patients and Lin et al[65] reported 16 cases with bronchiectasis who underwent VATS lobectomy. For primary lung cancer, our pre-operative clinical staging of patients enrolled in this procedure was less than stage 2 (T1N1, T2N1) which was the same as reported by Walker et al[2] but differed from most other reports[13,14,20,21,32,39,54] the inclusion criteria of which included clinical stage 1 (T1N0, or T2N0).

Patients with mediastinal node enlargement of more than 1 cm in diameter, demonstrated by CT scan, would undergo mediastinoscopy before pulmonary resection. Unfortunately, the final pathological report revealed 8 out of 27 cases (29.6%) were in stage 3A (T1N2 and T2N2). In most of other reports,[11,13,28-30,33,39,42,45,49,51,59] the diseases still confined in stage 1-2. Others[2,16,33,34,56,57] reported to have 1-25% (mean 11.2%) of their patients in stage 3; the figures were lower than ours.

Not only clinical benefits of VATS are observed over conventional surgery but also inflammatory reactions, as reflexed by lesser release of Cytokines. Several reports[19,29,66] prospectively studied and found significant difference in lower serum Interleukin (IL-6, IL-8) and C-reactive protein level after VATS thoracotomy. Sugi et al[42] found no difference in serum IL-6, IL-8 but lower pleural fluid IL-6 in VATS group. Leaver et al[67] found lower circulating T cell (CD 4) and natural killer lymphocytes (NK) in VATS patients. These proved that VATS procedure reduced body inflammatory responses when compared to conventional resection.

Some[2,5,6,8,11,16,32,34,48] reported patients in stage 1 NSCLC following VATS with 5-year survival at least as good as after standard procedure (Table 5). Kaseda et al[30] reported retrospective study comparing a 5-year survival of patients with stage 1 NSCLC and found significant difference ($p = 0.017$) between 44 VATS patients (5-yr survival at 97%) and 77 open thoracotomy (5-yr survival at 78.5%). Yim et al[8] prospectively studied patients in same stage and found similar results. They explained that metastases occured most frequently during the perioperative period, when injury and repair were most prominent and stress could elaborate various humoral substances that potentiated the growth of carcinomas.[30] On the other hand, Tatsumi et al[46] retrospectively compared patients with stage 1A Adenocarcinoma and found no difference in 5-year survival ($p = 0.98$) between 66 VATS patients (5-yr

Table 5 Survival rates following VATS lobectomy for stage 1 lung cancer: Results in the literature

Source	Year	No. of Patients	Conversion (%)	5-yr survival (%)
Yim et al[8]	1998	266	19.5	85
McKenna et al[11]	1998	212	7	76
Lewis et al[34]	1999	250	Not mentioned	92
Kaseda et al[32]	2000	204	11.7	97
Sugi et al[16]	2000	48	6.1	90
Walker et al[2]	2003	158	13.4	77.9
Roviaro et al[6]	2003	176	23	63.6
Gharagozloo et al[5]	2003	179	0	85
Ohtsuka et al[48]	2004	106	10	85

survival of 92.4%) and 50 conventional lobectomy patients (5-yr survival of 86.9%). Koizumi et al[45] reported similar results for stage 1 NSCLC patients but he[68] found that in stage 1 patients older than 80 years, the 5 year survival was 55.6% in VATS group and 0% in conventional group. Sugi et al[16] prospectively studied 48 VATS and 52 conventional stage 1 patients and found a 5-year survival of 90% and 85% respectively ($p = 0.74$). We personally argue that survival after both procedures are different in long term results.

Conclusion

A VATS lobectomy is a technically challenging operation and potentially safe one. The use of VATS leads to several benefits over conventional procedure. However, it needs steep learning curve particularly for developing country and we may have to modify the use of conventional thoracic instruments instead of disposable stapler.

REFERENCES

1. Lewis RJ, Caccavale RJ, Sisler GE, Mackenzie JW. One hundred consecutive patients undergoing video-assisted thoracic operation. Ann Thorac Surg 1992; 54: 421-6.
2. Walker WS, Codispoti M, Soon SY, Stamenkovic S, Carnochan F, Pugh G. Long-term outcomes following VATS lobectomy for non-small cell bronchogenic carcinoma. Eur J Cardiothorac Surg 2003; 23: 397-402.
3. McKenna RJ. Lobectomy by video-assisted thoracic surgery with mediastinal node sampling for lung cancer. J Thorac Cardiovasc Surg 1994; 107: 879-82.
4. Burfeind WR, D'Amico TA. Thoracoscopic Lobectomy. Op Tech Thorac Cardiovasc Surg 2004; 9: 98-114.
5. Gharagozloo F, Tempesta B, Margolis M, Alexader EP. Video-assisted thoracic surgery lobectomy for stage 1 lung cancer. Ann Thorac Surg 2003; 76: 1009-14.
6. Roviaro GC, Varoli F, Vergani C, Nucca O, Maciocco M, Grignani F. Long-term survival after videothoracoscopic lobectomy for stage 1 lung cancer. Chest 2004; 126: 725-32.
7. Lewis RJ. Simultaneously stapled lobectomy: a safe technique for video-assisted thoracic surgery. J Thorac Cardiovasc Surg 1995; 109: 619-25.
8. Yim AP. Video-assisted pulmonary resections. In: Pearson FG, Cooper JD, editors. Thoracic surgery. 2nd ed. New York: Churchill Livingstone, 2000; 1073-84.
9. Roviaro GC, Varoli F, Rebuffat C, et al. Major pulmonary resection: pneumonectomies and lobectomies. Ann Thorac Surg 1993; 56: 779-83.
10. Kirby TJ, Mack MJ, Landreneau RJ, et al. Initial experience with video-assisted thoracoscopic lobectomy. Ann Thorac Surg 1993; 56: 1248-53.
11. McKenna RJ, Fischel RJ, Wolf R, Wurnig P. Video-assisted thoracic surgery (VATS) lobectomy for bronchogenic carcinoma. Semin Thorac Cardiovasc Surg 1998;10: 321-5.
12. Tschernko EM, Hofer S, Bieglmayer C, Wisser W, Haider W. Video-assisted wedge resection/lobectomy vs conventional axillary thoracotomy. Chest 1996; 109: 1636-42.
13. Ohbuchi T, Morikawa T, Takeuchi E, Kato H. Lobectomy: video-assisted thoracic surgery versus posterolateral thoracotomy. Jpn J Thorac Cardiovasc Surg 1998; 46: 519-22.
14. Sugiura H, Morikawa T, Kaji M, Sasamura Y, Kondo S, Katoh H. Long-term benefits for the quality of life after video-assisted thoracoscopic lobectomy in patients with lung cancer. Surg Laparosc Endosc Percutan Tech 1999; 9: 403-8.
15. Demmy TL, Curtis JJ. Minimally invasive lobectomy directed toward frail and high-risk patients: a case control study. Ann Thorac Surg 1999; 68: 194-200.
16. Sugi K, Kaneda Y, Esato K. Video-assisted thoracoscopic lobectomy achieves a satisfactory long-term prognosis in patients with clinical stage 1A lung cancer. World J Surg 2000; 24: 27-30.
17. Tajiri M, Maehara T, Nakayama H. Thoracoscopic lobectomy

(non rib-spreading method): versus a video assisted lobectomy and a conventional thoracotomy. Kyobu Geka 2000; 53: 13-7.
18. Nakata M, Saeki H, Yokoyama N. Pulmonary function after lobectomy: video-assisted thoracic surgery versus thoracotomy. Ann Thorac Surg 2000; 70: 934-41.
19. Yim AP, Wan S, Lee TW, Arifi AA. VATS lobectomy reduce cytokine responses compare with conventional surgery. Ann Thorac Surg 2000; 70: 243-7.
20. Kirby TJ, Mack MJ, Landreneau RJ, Rice TW. Lobectomy-video-assisted thoracic surgery versus muscle sparing thoracotomy. A randomized trial. Thorac Cardiovasc Surg 1995; 109: 997-1002.
21. Kawahara K, Iwasaki A, Shiraishi T, Okabayashi K, Shirakusa T. Video-assisted thoracoscopic lobectomy for treating lung cancer. Surg Laparosc Endosc 1997; 7: 219-22.
22. Landreneau RJ, Hazelrigg SR, Mack MJ, et al. Postoperative pain-related morbidity: video-assisted thoracic surgery versus thoracotomy. Ann Thorac Surg 1993; 56: 1285-9.
23. Lewis RJ, Caccavale RJ, Sisley GE, Mackenzie JW. Video-assisted thoracic surgery resection of malignant lung tumors. J Thorac Cardiovasc Surg 1992; 104: 1679-87.
24. Inada K, Shirakusa T, Yoshinaga Y, et al. The role of video-assisted thoracic surgery for the treatment of lung cancer: lung lobectomy by thoracoscopy versus the standard thoracotomy approach. Int Surg 2000; 85: 6-12.
25. Nomori H, Horio H, Naruke T, Suemasu. What is the advantage of a thoracoscopic lobectomy over a limited thoracotomy procedure for lung cancer surgery? Ann thorac Surg 2001; 72: 879-84.
26. Fanta J. Video-assisted thoracic surgery - lobectomy, pneumonectomy. Rozhl Chir 1996; 75: 375-9.
27. Walker WS. Video-assisted thoracic surgery: pulmonary lobectomy. Semin Laparosc Surg 1996; 3: 233-44.
28. Inaoka M, Obama T, Kawaharada N. Video-assisted minithoracotomy versus conventional posterolateral thoracotomy for performing lobectomy of lung carcinomas. Kyobu Geka 2000; 53: 18-21.
29. Naghiro I, Andou A, Aoe M, et al. Pulmonary function, postoperative pain, and serum cytokine level after lobectomy: a comparison of VATS and conventional procedure. Ann Thorac Surg 2001; 72: 362-5.
30. Kaseda S, Aoki T, Hangai N, Shimizu K. Better pulmonary function and prognosis with video-assisted thoracic surgery than with thoracotomy. Ann thorac Surg 2000; 70: 1644-6.
31. Nakajima J, Takamoto S, Kohno T, Ohtsuka T. Cost of videothoracoscopic surgery versus open resection for patients with lung carcinoma. Cancer 2000; 89 (Suppl 11): 2497-501.
32. Koizumi K, Tanaka S, Haraguchi S, et al. Lobectomy by video-assisted thoracic surgery for primary lung cancer : experience based on provisional indications. Surg Today 1998; 28: 36-40.
33. Iwasaki A, Shirakusa T, Kawahara K, et al. Is video-assisted thoracoscopic surgery suitable for resection of primary lung cancer? Thorac Cardiovasc Surg 1997; 45: 13-5.
34. Lewis RJ, Caccavale RJ, Bocage JP, Widmann MD. Video-assisted thoracic surgery non rib spreading simultaneously stapled lobectomy. Chest 1999; 116: 1119-24.
35. Kaseda S, Hangai N, Yamamoto S, Kitano M. Lobectomy with extended lymph node dissection by video-assisted thoracic surgery for lung cancer. Surg Endosc 1997; 11: 703-6.
36. Kaseda S, Aoki T, Hangai N. Video-assisted thoracic surgery (VATS) lobectomy: the Japanese experience. Semin Thorac Cardiovasc Surg 1998; 10: 300-4.
37. Sagawa M, Sato M, Sakurada A, et al. A prospective trial of systematic nodal dissection for lung cancer by video-assisted thoracic surgery: can it be perfect? Ann Thorac Surg 2002; 73: 900-4.
38. Kaseda S, Aoki T. Video-assisted thoracic surgery lobectomy in conjunction with lymphadenectomy for lung cancer. Nippon Geka Gakkai Zasshi 2002; 103: 717-21.
39. Kirby TJ, Rice TW. Thoracoscopic lobectomy. Ann Thorac Surg 1993; 56: 784-6.
40. Coosemans W, Lerut TF, Van Raemdonck DE. Thoracoscopic surgery: the Belgian experience. Ann Thorac Surg 1993; 56: 721-30.
41. Hermansson U, Konstantinov IE, Aren C. Video-assisted thoracic surgery (VATS) lobectomy: the initial Swedish experience. Semin Thorac Cardiovasc Surg 1998; 10: 285-90.
42. Sugi K, Kaneda Y, Esato K. Video-assisted thoracoscopic lobectomy reduces cytokine production more than conventional open lobectomy. Jpn J Thorac Cardiovasc Surg 2000; 48: 161-5.
43. Solaini L, Prusciano F, Bagioni P, et al. Video-assisted thoracic surgery major pulmonary resections. Present experience. Eur J Cardiothorac Surg 2001; 20: 437-42.
44. Koshioishi Y, Oono Y, Goya T. Less invasive surgery for the small size peripheral lung cancer: an indication and a review of VATS lobectomy. Kyobu Geka 2001; 54: 947-50.
45. Koizumi K, Haraguchi S, Hirata T, et al. Video-assisted lobectomy in elderly lung cancer patients. Jpn J Thorac Cardiovasc Surg 2002; 50: 15-22.
46. Tatsumi A, Ueda Y. Video-assisted thoracic surgery for lung cancer: is it a feasible operation for stage 1 lung cancer? Jpn J Thorac Cardiovasc Surg 2003; 51: 646-50.
47. Klena JW, Saari AF, Peterson DO, Collins C, Johnson JA. Combined video-assisted thoracoscopic lung volume reduction surgery and lobectomy in a high-risk patient. Ann Thorac Surg 2003; 76: 2079-80.
48. Ohtsuka T, Nomori H, Horio H, Naruke T, Suemasu K. Is major pulmonary resection by video-assisted thoracic surgery an adequate procedure in clinical stage 1 lung cancer? Chest 2004; 125: 1742-6.
49. Shigemura N, Akashi A, Nakagiri T, et al. Complete versus assisted thoracoscopic approach: a prospective randomized trial comparing a variety of video-assisted thoracoscopic lobectomy technique. Surg Endosc 2004; 18: 1492-7.
50. Lewis RJ, Caccavale RJ. Video-assisted thoracic surgery

non- rib spreading simultaneously stapled lobectomy (VATS (n) SSL). Semin Thorac Cardiovasc Surg 1998; 10: 332-9.
51. Leschber G, Holinka G, Linder A. Video-assisted mediastinoscopic lymphadenectomy (VAMLA) - a method for systematic mediastinal lymph node dissection. Eur J Cardiothorac Surg 2003; 24: 192-5.
52. McKenna RJ. New approaches to the minimally invasive treatment of lung cancer. Cancer J 2005; 11: 73-6.
53. Hazelrigg SR, Nunchuck SK, Locicero J. Video assisted thoracic surgery study group data. Ann Thorac Surg 1993; 56: 1039-44.
54. Kirby TJ, Mack MJ, Landreneau RJ, Rice TW. Initial experience with video-assisted thoracoscopic lobectomy. Ann Thorac Surg 1993; 56: 1248-53.
55. Walker WS, Pugh GC, Craig SR, Carnochan FM. Continued experience with thoracoscopic major pulmonary resection. Int Surg 1996; 81: 255-8.
56. Walker WS. Video-assisted thoracic surgery (VATS) lobectomy: the Edinburgh experience. Semin Thorac Cardiovasc Surg 1998; 10: 291-9.
57. McKenna RJ, Wolf RK, Brenner M, et al. Is lobectomy by video-assisted thoracic surgery an adequate cancer operation? Ann Thorac Surg 1998; 66: 1903-8.
58. Nomori H, Ohtsuka T, Horio H, et al. Thoracoscopic lobectomy for lung cancer with a largely fused fissure. Chest 2003; 123: 619-22.
59. Sugi K, Hirazawa K, Matsuda E, Kaneda Y. Intrathoracic bleeding during video-assisted thoracoscopic lobectomy and segmentectomy. Kyobu Geka 2003; 56: 928-31.
60. Maehara T, Takei H, Nishii T, et al. Intraoperative conversion and postoperative complication of video-assisted thoracoscopic surgery lobectomy for primary lung cancer. Kyobu Geka 2003; 56: 939-42.
61. Watanabe A, Osawa H, Watanabe T, et al. Complication of major lung resections by video-assisted thoracoscopic surgery. Kyobu Geka 2003; 56: 943-8.
62. Daniel TM, Kern JA, Tribble CG, et al. Thoracoscopic surgery for diseases of the lung and pleura: effectiveness, changing indications, and limitations. Ann Surg 1993; 217: 566-74.
63. Stammberger U, Steinacher C, Hillingger S, et al. Early and long-term complaints following video-assisted thoracoscopic surgery: evaluation in 173 patients. Eur J Cardiothorac Surg 2000; 18: 7-11.
64. Weber A, Stammberger U, Inci I, et al. Thoracoscopic lobectomy for benign disease - a single centre study on 64 cases. Eur J Cardiothorac Surg 2001; 20: 443-8.
65. Lin TS, Lai CY, HO ML, Chou MC. Video-assisted thoracoscopic lobectomy for right middle lobe bronchiectasis. Int Surg 2004; 89: 136-9.
66. Craig SR, Leaver HA, Yap PL, Pugh GC, Walker WS. Acute phase responses following minimal access and conventional thoracic surgery. Eur J Cardiothorac Surg 2001; 20: 455-63.
67. Leaver HA, Cgaig SR, Yap PL, Walker WS. Lymphocyte responses following open and minimally invasive thoracic surgery. Eur J Clin Invest 2000; 30: 230-8.
68. Koizumi K, Haraguchi S, Hirai K, et al. Lobectomy by video-assisted thoracic surgery for lung cancer patients age 80 years or more. Ann Thorac Cardiovasc Surg 2003; 9: 14-21.