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Thoracoscopic lobectomy for benign disease – a single centre study on 64 cases ☆

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Abstract

Objective: Chronic lung infection is the main indication for lobectomy in benign pulmonary disease and may be technically demanding due to inflammatory changes such as adhesions, lymph node enlargement and neovascularization. The role of the thoracoscopic operation in these indications is yet ill-defined. **Methods**: We retrospectively analyzed the results of patients who underwent thoracoscopic lobectomy (TL) between 1992 and June 1999 and compared this study group with patients who underwent open lobectomy (OL), all for benign disease. Data were not normally distributed, therefore, the median and range is given and nonparametric statistical analysis was applied. **Results**: A total of 117 lobectomies for benign disease (64 TL) were analyzed. Indications included bronchiectasis (36 TL; 18 OL), chronic infections (13 TL; eight OL), tuberculosis (five TL; 15 OL), emphysema (five TL; one OL), AV-malformations (two TL; one OL), severe haemoptysis (four OL), and others (three TL; six OL). Twelve conversions to thoracotomy were necessary due to severe adhesions. One patient in the open lobectomy group died within 30 days postoperative. Drainage time was 5.0 (1–32) days in TL and 6.0 (3–21) days in OL, hospital stay was 8.5 (4–41) days and 10.0 (5–52) days, respectively. Blood loss was 0 (0–2000) ml in TL and 300 (0–6000) ml in OL.Operation time for thoracoscopic lobectomies significantly decreased from 2.5 (1–6) h for cases between 1992 and 1997 ($n = 49$) to 1.5 (0.5–2.5) h for recent cases ($n = 15$) ($P < 0.01$). In addition, a trend towards less blood loss was noted (100 (0–2000) ml vs. 0 (0–400) ml; $P = 0.06$). Drainage time and hospital stay did not differ significantly. **Conclusions**: Thoracoscopic lobectomy in chronic inflammatory disease can be performed safely in selected patients, especially with bronchiectasis. Conversion rate to thoracotomy is low. Operation time with this approach declined significantly over time.

Keywords: Video-assisted-thoracoscopic-surgery; Lobectomy; Benign-lung-disease

1. Introduction

Advances in video-assisted thoracoscopic surgery (VATS) instruments, imaging technology and surgical techniques have promoted a rapid increase in the number and variety of operations performed using this technique. Several clinical series demonstrated that VATS had similar efficacy to open thoracotomy while providing the benefits of decreased pain-related morbidity, functional disability and hospital stay [1–7]. Successful implementation of this goal has made VATS the preferred approach to the diagnosis and treatment of many thoracic disease processes.

The technical feasibility of major lung resections using VATS have been shown by several surgeons [8–17]. However reports in the literature on thoracoscopic anatomic lung resections were almost exclusively devoted to the treatment of early bronchogenic carcinoma with few exceptions (Table 1). VAT lobectomy for benign lung disease has been specifically addressed by Yim [15] reporting on ten cases.

Chronic lung infection is the main indication for lobectomy in benign pulmonary disease and therefore may be technically demanding due to acute and chronic inflammatory changes such as adhesions, lymph node enlargement and increased bleeding due to neovascularization. The role of the thoracoscopic operation in these situations is yet ill-defined.

Herein, we report our experience with 64 patients treated with VATS lobectomy for benign lung disease in order to define indications and limits.

2. Material and methods

From January 1992 to June 1999, 117 patients underwent lobectomy for benign disease at our institution. Among them, 64 selected patients underwent a VAT-lobectomy

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Table 1
Major published series of video-assisted thoracic surgical lobectomy and pneumonectomy [17][a]

Reference	No.	Cancer	Benign	Mortality (%)	Length of stay
Lewis & Caccavale (1998)	200	171	29	0	3.07
Yim et al. (1998)	214	168	56	1 (0.4)	6.8
Kasada et al. (1998)	145	103	42	1 (0.8)	NA
Hermansson et al. (1998)	30	15	15	0	4.4
Walker et al. (1996)	150	123	27	3 (2)	7.2
Roviaro et al. (1998)	169	142	27	1 (0.5)	NA
McKenna et al. (1998)	212	212	0	1 (0.5)	4.6
Weber et al.	64	0	64	0	8.5
Total	1184	934	260	7 (0.6)	5.28

[a] No., number of patients. NA, not available.

and 53 patients a conventional open lobectomy after informed consent was obtained.

Selection criteria included symptomatic patients who had failed medical treatment, continued to have productive cough, hemoptysis and failure to thrive. In some instances patients were admitted on an emergency basis for acute hemoptysis. All patients received routine chest X-ray and a high resolution computed tomograph scanning of the thorax while the majority underwent a bronchoscopy. In all elective cases pulmonary function was determined by spirometry. In cases of respiratory limitation a perfusion lung scan was added. Patients were selected for VATS if they were under stable cardio-pulmonary conditions and the procedure was planned as an elective operation. In cases with evidence for severe parenchymal and or pleural scarring on CT scan we directly performed an open procedure. This selection was based on the surgeon's judgement. Patient characteristics, type of lobectomies and indications are shown in Tables 2 and 3.

After induction of general anaesthesia with a double lumen endotracheal tube, the patient is placed in a full lateral decubitus position with the upper arm suspended on a crossbar.

In VATS procedures, a collapse of the lung was achieved with unilateral lung ventilation, and the first 10 mm trocar was introduced in the sixth (for upper lobe), seventh (for middle and lower lobes) or eighth (lung sequestration, heavy scarring on the diaphragm) intercostal space on the midaxillary line. The optical instrument with a 30° lens and videocamera (Wolf CCT- Endocam 5370) attached was introduced, the cavity was carefully explored and the feasibility of a videoscopic procedure was confirmed. The operating trocars were then inserted under direct endoscopic control, usually in the fourth, fifth or sixth intercostal space (Fig. 1).

We use three 10 mm trocars and one or two 5/6 mm trocars. All preparations are done through the inserted trocars and at the end of the procedure the lobe is removed in a plastic bag from the enlarged ventral trocar port (6–8 cm).

In thoracoscopic lobectomy with minithoracotomy we use two 10 mm trocars and one 5 mm trocar, followed by the union of two trocar ports with the result of an anteriolateral minithoracotomy (8–10 cm) without rib cutting. In this method some of the preparations are done through the minithoracotomy incision.

The hilar dissection is done as in open lobectomy. This included the individual isolation of vessels and bronchus. Dissection was performed using electrocoagulating endoscissors or endoswabs, for blunt dissection. All major pulmonary arteries and veins were transected using endoscopic stapling devices (Endo GIA-30-Autosuture). Lobar bronchi were closed by a linear stapling device (TLH-30 or the ET 45 B, Ethicon). Incomplete fissures were divided by using a stapler (ET 45, Ethicon).The lung

Table 2
Characteristics of the study groups[a]

	VATS/1992—1999 $n = 64$		Open lobectomy $n = 53$		VATS/1998 + 1999 $n = 15$	
Sex	36 F/28 M		25 F/28 M		11 F/4 M	
Age (mean)	54.5 (20—81)		47.1 (17–82)		51.8 (36—75)	
Type of lobectomy	*n*	%	*n*	%	*n*	%
RUL	7	11	13	25	0	
ML	23	36	7	13	9	60
RLL	8	12	7	13	1	
LUL	9	14	12	23	1	
LLL	17	27	14	26	4	26

[a] F, female; LLL, left lower lobectomy; LUL, left upper lobectomy; M, male; ML, middle lobectomy; RLL, right lower lobectomy; RUL, right upper lobectomy; VATS, video-assisted thoracoscopic surgery.

Table 3
Indications according to the groups[a]

	VATS/1992—1999		Open lobectomy		VATS/1998 + 1999	
Disease	*n*	*%*	*n*	*%*	*n*	*%*
Bronchiectasis	36	56	18	34	12	80
Chronic lung infections	13	20	8	15	3	
Tuberculosis	5	8	15	28	0	
Emphysema	5	1				
AV-malformations	2	1				
Severe hemoptysis	0	4				
Lung sequestration	3	3				
Others	0	3				

[a] *n*, number of patients.

specimen was then placed in a plastic bag for removal through a minithoracotomy incision. At the end of the procedure, usually two chest tubes were inserted through the trocar incisions and connected to a closed chest tube drainage system with suction of -25 cm H_2O.

We reviewed all data of the studied patients for indication, surgical technique, conversion rate from VATS to open lobectomy, resected lobe, operation time, blood loss, drainage time, hospital stay, early postoperative morbidity and mortality. We especially evaluated VATS lobectomies which were carried out in the last 2 years and compared them with those performed in the early phase.

2.1. Statistical analysis

Data were analyzed with Mann–Whitney *U*-test. All values are expressed as median and range. A P value less than 0.05 was considered significant.

3. Results

In 76 cases we intended to perform a video-assisted thoracoscopic lobectomy. This procedure was successfully completed in 64 patients. In 12 cases the thoracoscopic approach (15.3%) had to be converted to a antero-lateral thoracotomy because of either dense adhesions, massive inflammatory lymph node enlargement with neovascularization or a closed fissure. The conversion rate to thoracotomy between 1992 and 1997 was 15.8% and was comparable with the second phase performed between 1998 and 1999 (10.2%). There was no emergency conversion thoracotomy due to a major bleeding.

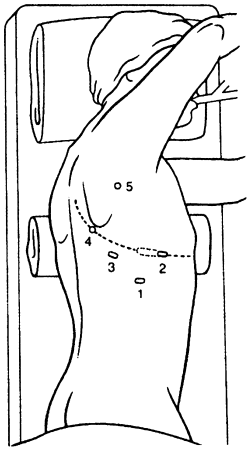

Fig. 1. (1) Main trocar port for camera; (2) operating trocar (exchangeable for camera); (3) operating trocar (exchangeable for camera); (4) lung forceps (5 mm); (5) lung forceps (5 mm).

In 17 of 64 cases an early minithoracotomy of 8–10 cm. was necessary to ease the dissection of inflammatory changes. In the other cases the minithoracotomy (6–8 cm) was done at the end to harvest the resected lung specimen.

There was no hospital death in the VATS group. One patient in the open lobectomy group died within 30 days postoperatively due to multiorgan failure after an emergency operation because of massive hemoptysis. A total of 17 patients underwent an urgent operation because of hemoptysis and all of them were managed with a standard lobectomy. Of these, four patients with massive bleeding had an emergency operation.

Operation time, blood loss, drainage time and hospital stay for VATS lobectomy were lower compared to open thoracotomy, but the differences did not reach statistical significancy. However operation time significantly decreased for VATS lobectomy between 1998 and June 1999 compared to those between 1992 and 1997 ($P = 0.01$). In addition, a trend towards less blood loss, fewer drainage time and hospital stay was noted (Table 4).

Twelve patients (18.7%) of the VATS lobectomy group and 23 (43.4%) of the open lobectomy group experienced nonfatal complications. Prolonged parenchymal fistulas (>7 days) developed in six cases among VATS (9.3%) and five cases among open lobectomy patients (9.4%). One patient (1.5%) developed a hemothorax in the VATS group compared to seven (13.2%) patients after open lobectomy. After VATS lobectomy 3 patients (4.7%) required reoperation, all for control of pneumothorax caused by parenchymal fistulas. In the open lobectomy group seven patients (13.2%) required reoperation for control of hemothorax or prolonged air leak. Postoperative pneumonia developed in three patients (4.7%) after video-assisted procedure and eight

Table 4
Operative and postoperative results of the groups

	VATS/1992–1999	Open lobectomy	VATS/1998 + 1999
Operating time, hours			
Median	2	2.5	1.5
Range	0.5–6	1–4	0.5–2.5
Blood loss, ml			
Median	0	300	0
Range	0–2000	0–6000	0–400
Drainage time, days			
Median	5	6	5
Range	1–32	3–21	1–9
Hospital stay, days			
Median	8.5	10	7.5
Range	4–41	5–52	4–16

(15%) after standard thoracotomy. Postoperative cardiac arrhythmias, occurred in two of VATS and three of open lobectomy cases. Overall complication rate was reduced to 10% among the last twenty VATS patients.

4. Discussion

There have been several reports testifying the technical feasibility of video-assisted thoracoscopic major lung resections [9–14]. In the early 1990s, difficulties were due to the lack of adequate thoracoscopic instrumentation [10]. As predicted by Giudicelli [8], thanks to advances in videoendoscopic instrumentation and endosurgical techniques, the indications of video-assisted lobectomy have been extended to a larger patient population in the last few years.

Results of published series of VATS lobectomy and pneumonectomy [17] showed favourable results compared with a thoracotomy (Table 1). In these series, complications occurred in 10.0–21.9%. Conversion from VATS to thoracotomy was necessary in 0–19.5% of patients. Overall, 119 of 1120 operations were converted to thoracotomy (11.6%). Most commonly, oncologic reasons prompted the conversion. Approximately 30% of the conversions to thoracotomy were for nononcologic reasons, such as pleural symphysis. A direct comparison between these two groups is rather difficult because of the heterogeneity of the patients characteristics.

However, there are major differences between anatomic resections of benign or malignant disease through minimal access. The existing literature is mostly devoted to the treatment of early bronchogenic carcinoma [15] (Table 1).

Yim and co-workers [15] discussed for the first time VATS lobectomies specifically for benign disease in ten cases. They reported three major differences compared to resection for malignant disease. First, adequacy of tumor clearance is not relevant. Second, inflammatory changes may render dissection more difficult especially in certain disease like tuberculosis. Third, while tumor seeding is a concern in malignant neoplasms, wound infection is a concern in resections for an infectious disease.

Roviaro and co-workers [10] stated that all benign pulmonary disease can be explored thoracoscopically, but the feasibility of resection depends on the local anatomic situation especially adhesions. They described that in the setting of inflammatory pathologic conditions such as purulent bronchiectasis, dissection of the pulmonary vessels within the fissure may be very difficult if there were dense adhesions or enlarged lymph nodes, especially calcified.

In our experience we found that the severity of adhesions to the chest wall, the hilum and especially in the fissure, typically seen in inflammatory disease is the key limiting factor for a safe VATS lobectomy. It necessitates patience for the surgeon to complete the operation by VATS. Adhesions have to be dissected stepwise to safely explore the relevant anatomy. Destroyed lobes mainly after tuberculosis with or without aspergillosis were all directed to open lobectomy due to these difficulties. It is not surprising that prolonged air leaks were the major morbidity both after VATS as well as open lobectomy for inflammatory disease. However wound infections were not seen in trocar sites nor in the thoracotomy.

In our series the conversion rate from VATS to thoracotomy was 15.3%. We consider this not as a failure rather than a safety measure. All these patients suffered from extended adhesions with chronic inflammatory changes, except for one patient with a large arterio-venous malformation of the middle lobe. Among the VATS lobectomy group, 50% of patients with tuberculosis had to be managed with an open lobectomy finally.

Considering the subgroup of patients operated on for bronchiectasis and undergoing middle lobe resection between 1998 and 1999, conversion rate fell to 6.25% (10.3% for the whole group). Furthermore, for these the overall complication rate was only 10% and the operation time was significantly shorter. In addition there was no mortality and a trend towards less blood loss, shorter drainage time and hospital stay was achieved.

Twelve patients (18.7%) of the VATS lobectomy group experienced nonfatal complications. This is comparable to the data in a collected review were the complication rate

was between 10–22% (Table 1). We did not perform an emergency conversion to thoracotomy, which happened in ten cases within studies.

In the VATS group middle and lower left lobectomies were most often performed. These are technically easier than upper lobectomies, especially on the left side [12,18–20]. However all other possible lobectomies were also performed safely, but in less number. A trend to mainly middle and lower lobectomy was seen in the last 2 years with more than 90%. This corroborates a more selective disease- and localization-related indication for video-assisted thoracoscopic management of benign diseases.

More than 2/3 of our bronchiectasis patients were successfully treated with a video-assisted thoracoscopic lobectomy. Segmentectomy may be the surgical treatment of choice in situations with well-localized bronchiectasis [22]. However all of these were done as open procedures.

On the contrary, all type of lobectomies, independent from the technical difficulties, were carried out by a standard thoracotomy. Compared with VATS, more upper lobes were resected where tuberculosis is more likely to be localized [21].

Only in five selected cases of tuberculosis VATS lobectomy was successfully completed. Dense adhesions and calcified lymph nodes, led to a high conversion rate to thoracotomy (50%). In addition, in patients with known or presumed tuberculosis, with extensive intraparenchymal scarring, the question of malignancy is often present. Therefore, the management of these individuals, must be adjusted. Between 1998 and 1999, all patients with tuberculosis were directed to standard thoracotomy for lobectomy.

Our results suggest that video assisted thoracoscopic lobectomy in chronic inflammatory diseases can be performed safely in selected patients, especially with bronchiectasis. Radiological signs of severe scarring and adhesions on CT scan indicates the need of thoracotomy. Beside adequate selection, the growing experience of the surgeon has an important impact on the outcome [7]. Since our patients were pleased with the rapid postoperative recovery and the favorable cosmetic result, it became the surgical treatment of choice for these indications.

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Appendix A. Conference discussion

Dr H.B. Ris *(Lausanne, Switzerland)*: You did most of your operations for bronchiectasis, and, as far as I understood, most of these bronchiectases were localized in the lower lobes. Why have you not considered a segmentectomy? Usually the bronchiectases are situated in the basal segments leaving a nice and voluminous superior segment and I always find it a pity to sacrifice this segment. Could you comment on that, please?

Dr Weber: We also agree that segmentectomy has to be considered for bronchiectasis, but for well-localized bronchiectasis only. In these cases, bronchiectases weren't as localized, so lobectomy couldn't be avoided.

Dr P. Thomas *(Marseille, France)*: In Marseille we have strictly the same figures that you showed. I have a question regarding what you call your standard thoracotomy. Do you use a muscle-sparing thoracotomy, and, if so, do you note any difference between video-assisted minithoracotomy and a standard muscle-sparing thoracotomy?

Dr Weber: Our standard thoracotomy is an anterolateral thoracotomy with rib cutting. We did not study the difference in regard of pain etc. between the two groups.

Dr Thomas: In your opinion, what is the main benefit of VATS surgery for lobectomy, for major pulmonary resection in the setting of benign disease?

Dr Weber: We can say at this point that the patient's opinion is really important. All of them prefer this approach. The patient's comfort after the operation is much better. It has been also reported that compared to open thoracotomy, this technique compares favorably to it.

Dr G. Cardillo *(Rome, Italy)*: You have treated three patients with lung sequestration by VATS. Did you know the diagnosis before surgery? Do you think that sequestration is a safe indication for VATS?

Dr Weber: In these cases the diagnosis was expected from the CT scan. It was in a few cases and it was safe. They were all intrapulmonary sequestration.

Dr Ris: Walter, do you want to comment on that?

Dr W. Weder *(Zurich, Switzerland)*: Indeed VATS lobectomy for lung sequestration may be a critical issue. First you must anticipate the diagnosis from the CT scan; otherwise, your preparation above the diaphragm could lead to a major bleeding by injuring the aberrant artery. In these three cases we completed all procedures by VATS. The artery was nicely seen and safely divided by a stapler. In three other cases they were done by open thoracotomy. All of them were started by VATS, but because of dense adhesions the isolation of the artery was not safe. We converted at times to an open procedure just for safety reasons. So I think it depends very much on the wound and quality of adhesions during surgery.

Dr El-Sayed *(Khartoum, Sudan)*: Who was performing the thoracotomies, the standard thoracotomies? From your slide they were taking 2.5 h as opposed to 2 h in VATS. So were the standard thoracotomies being performed by junior trainees, for example?

Dr Weber: I think Professor Weder should answer this question.

Dr W. Weder: As we already pointed out, we cannot compare the VATS group with the open group, because in the open group we selected all emergency cases or cases with severe adhesions, for example patients with severely destructed lobes from tuberculosis. So you cannot compare these two groups with each other because the indications were slightly different. On the other hand, all VATS lobectomies were done by the senior author and open cases by trainees as well.