

Extra-anatomical VATS lung resection: the outpatient experience with the aid of a digital chest drain device

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Abstract. – OBJECTIVE: The aim of the present study was to evaluate the feasibility of video-assisted thoracic surgery (VATS) wedge resections in an outpatient setting using a digital air leak detection device.

PATIENTS AND METHODS: Data from all patients who underwent outpatient VATS wedge resections from November 2010 to November 2013 was analyzed. The thoracoscopic approach was done in all cases under general anesthesia, with double lumen intubation, three port sites and one or two wedge resections without the reinforcement of the suture line. The chest-drain with continuous suction (–20 cm/H₂O) placed after surgery was removed when no air leak (0-10 ml/min) was detected digitally within two hours after surgery. Patients were discharged after exclusion of pneumothorax by chest x-ray. Patient distribution according to gender, smoking habit, indication for resection, number of wedge resections, and histological findings was compared.

RESULTS: In the study period, 66 VATS patients (44.3%) of all VATS procedures were eligible for the outpatient procedure. Fifty-five of them (83.3%) were discharged on the same day, while 11 were admitted due to patients preference, presence of an air leak or for other medical reasons. In the outpatient group (OG) the indications for surgery were lung nodules in 90.9% (50 cases) and interstitial disease in the remaining 9.1%. In the OG, 18 patients (32.7%) received two wedge resections. All patients had no leak detected by digital device prior to drainage removal. The overall re-admission rate was 7.3% (4/55). Statistical analysis did not

show any difference regarding sex, smoking habits, indications for surgery, number of parenchymal resection, disease localization, and malignant histology. All patients who had an outpatient procedure confirmed that they would repeat the procedure.

CONCLUSIONS: Outpatient thoracoscopic non-anatomic resections managed with a digital chest drain device have both low complication rates as well as lead to fewer re-admissions. Because of the growing number of VATS Wedge Resections due to pre-identified lung nodules, this could have important implications. Further research should identify the most suitable subgroup of patients for this approach.

Key Words:

Outpatient, VATS, Wedge, Lung, Resection, Digital device.

Introduction

Outpatient surgery has become standard operating procedure with the development of minimal invasive surgical techniques, improved anaesthetic techniques, and short-acting anaesthetic drugs. Patient satisfaction is high, nosocomial infection rates are reduced, and outpatient procedures cost significantly less. There are only few reports of outpatient videothoracoscopic surgery likely due to frequent need for a chest drain at the end of the procedure¹⁻³. However, there are outpatient

programs involving patients undergoing VATS sympathectomy, mediastinoscopy, and anterior mediastinotomy^{4,5}. With the traditional drainage systems the indication for removal of the chest tube was highly observer dependent. The aim of this study was to evaluate the feasibility of VATS wedge lung resection as an outpatient procedure using a digital device, which allows continuous air leak measurement.

Patients and Methods

Data of all patients who underwent VATS wedge resections at the San Giovanni Hospital in Bellinzona from November 2010 to November 2013 were retrospectively analyzed. Our primary end-point was to evaluate the feasibility of outpatient VATS wedge resection with the use of a digital chest drain system (Thopaz®; Medela Healthcare, Baar, Switzerland). We, therefore, excluded all VATS procedures performed in admitted patients.

All patients were seen prior to surgery and informed on three different postsurgical scenarios: (1) discharge on the day of the procedure; (2) admission of the patient due to patients preference, without any surgical or medical reason; (3) admission for medical or surgical reasons (intraoperative difficulties, pulmonary air leak more than 10 ml/min, nausea, pain). No patient was forced to leave the hospital on the same day of surgery. An informed consent was obtained in all cases. Exclusion criteria for outpatient procedures were anticoagulant therapy, significant comorbidities, limited pulmonary function ($FEV_1\% < 70$) and geographical reasons. Distance from the hospital had to be no longer than 30 minutes driving time.

Surgical Protocol and Pain Management

All interventions were performed in the morning in order to observe the patients during the day. Cefazolin was administered as perioperative antibiotic prophylaxis. All interventions were performed under general anaesthesia with double-lumen endotracheal tube in lateral decubitus position. Pre-incisional infiltration with 2 ml 0.5% Bupivacaine on each incision site was done in every patient. Oral analgesics consisted in Ibuprofen 400 mg tid and Paracetamol 500 mg. Opioid analgesics were excluded to avoid side effects in the outpatient situation. Three incisions were used for access and we usually used a 7 mm 30° optic. All wedge resections were performed

using linear stapling devices without reinforcement of the suture-lines. One chest tube was placed and connected to a chest drainage system with digital real-time monitoring of the air leak (ml/min) set at -20 cm/H₂O of continuous suction (Thopaz®; Medela Healthcare, Baar, Switzerland). The chest tube was removed when no air leak (0-10 ml/min) was detected within two hours after surgery followed 2 hours later by a chest X-ray to exclude pneumothorax or pleural effusion. If there were no medical contraindications (pneumothorax, pleural effusion, arrhythmias, significant blood loss, etc.) the patient was free to decide whether to stay or go home on the same day of surgery. All patients were followed up in our outpatient clinic within 3-5 days after surgery.

Statistical Analysis

Continuous variables were described as mean/standard deviation, categorical variables as actual numbers/percentages. Patients who were admitted were compared with those not admitted after surgery. Continuous variables were compared with the Student's *t*-test, with correction for unequal variances when required. Correlations between factors were assessed by Chi square or Fisher's exact tests for categorical variables.

A logistic regression analysis model was done to assess the influence of independent variables on occurrence of admission or readmission. $p < 0.05$ was defined as statistically significant. Statistical analysis was performed with SPSS 14.0 for Windows (SPSS Statistical Software, Chicago, IL, USA).

Results

From November 2010 to November 2013, 149 non-anatomic lung resections were done at the San Giovanni Hospital in Bellinzona. 66 wedge resections were performed in patients considered suitable for an outpatient procedure (group 1) and 83 on admitted patients (group 2). Patients in group 2 were not followed and therefore excluded from our analysis. Among the 66 patients in group 1, 55 (83.3%) were discharged the same day, while 11 patients were admitted. Reasons for admittance were: patients' preference, presence of an air leak detected by digital device or for other medical reasons (nausea or pain) (Figure 1). Patient characteristics are listed in Table I.

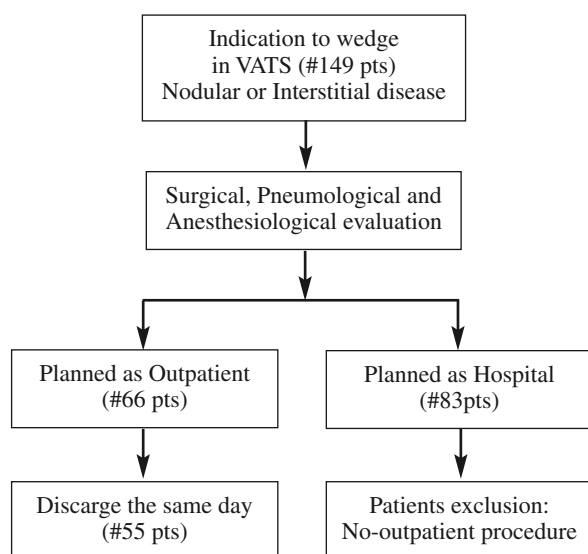


Figure 1. Consort diagram.

In the outpatient cases the indications for surgery consisted of lung nodules in 50 cases (90.9%), and in five cases (9%) interstitial lung disease. In 11 patient (33.4%) patients more than one wedge resection was performed. No mortality and no morbidity were seen. The overall hospital readmission rate of patients who initially went home on the same day they had surgery was 7.3% (4/55 patients). The reason for readmission included pain (n=1), subcutaneous emphysema (n=1) and a pneumothorax (n=2). Data show that the Odds Ratio (OR) for readmission did not show a statistical significance regarding sex, smoking habits, indications for surgery, number of parenchymal resection, disease localization and malignancy (Table II).

Within group 1 no significant difference was found between outpatients and the admitted patients with respect to demographics, surgical procedure, intraoperative and pathological findings (Table III).

All day-surgery patients confirmed they would redo the procedure in a similar manner.

Discussion

We report our single-center case series of 55 consecutive outpatient VATS wedge resections for lung nodules and interstitial lung disease, where chest tube management was guided by the use of a digital chest drainage system.

VATS wedge lung resections have become the standard diagnostic approach for many different lung pathologies. Hospital stay is largely dependent on chest tube management. The chest tube removal is based on the daily fluid loss and the presence of air leak. Both are very observer dependent in conventional drainage systems and therefore standardization can be difficult^{6,7}. Many efforts have been made to reduce the post-operative length of stay⁸. The proper management of the chest tubes plays a key role⁹⁻¹².

Using a traditional chest tube system the air leak is “measured” by the amount of bubbles seen in the special chamber. Therefore, it is not only observer dependent, but also variable over time. This combination makes it difficult to judge the right moment for chest tube removal. After the introduction of stapling devices the risk of bleeding and air leaks were significantly reduced. This allowed surgeons to become more aggressive with their chest tube management^{13,14}. The first report on outpatient VATS wedge lung resection was by Chang et al in 2002¹ in which they removed the chest tube after surgery and the patient was discharged the same day. They reported a readmission rate due to pneumothorax of about 27%. Due to the high readmission rate reported

Table I. Clinical, operative, and pathologic characteristics of the overall population.

Characteristics of the Sample Population	Mean ± SD or number (%)
Age (mean ± SD)	61.5 ± 11.39
Age >/< 65 years	25 (45.5)
Male/Female	40/15
Smokers	30 (27.3)
Ex smokers	15 (54.5)
No smokers	10 (18.2)
Nodular lesions	50 (90.9)
Interstitial disease	5 (9.1)
Side right/left	35/20 (63.6/36.4)
Site	
Left upper lobe	12 (21.8)
Left lower lobe	8 (14.5)
Right upper lobe	6 (10.9)
Medium lobe	2 (3.6)
Right lower lobe	13 (23.6)
Bilateral lesion	12 (21.8)
One wedge resection	37 (67.3)
Two wedge resections	18 (32.7)
Malignant disease	26 (47.3)
Re-admission	4 (7.3)
Pneumothorax	2 (3.6)
Pain control	2 (3.6)

Table II. Logistic regression analysis of in-hospital admission risk according to sex, smoking habit, indication to resection, localization, number of parenchymal resection and presence of tumoral lesion.

Univariate Analysis	OR [95% CI]	p-value
Gender (female)	0.88 [0.84; 9.19]	0.91
Age > 65 years	1.27 [0.93; 1.13]	0.59
Active smokers	1.56 [0.14; 16.36]	0.71
Nodular disease	0.9 [0.76; 7.75]	0.99
Left side	1.83 [0.23; 14.13]	0.56
One wedge resection	1.5 [0.14; 15.52]	0.74
Two wedge resections	0.66 [0.64; 6.88]	0.74
Malignant disease	3.65 [0.35; 37.51]	0.27

by Chang et al¹, outpatient VATS approach for lung resection was not feasible. The majority of thoracic surgeons continued with their traditional chest tube management. Therefore only 115 outpatient VATS wedge lung resections were reported worldwide¹⁻³. The outpatient surgical approach to thoracic diseases was only considered to be safe when it didn't include lung resections^{4,5}.

The novelty of our study is that chest tube management is based on digital data excluding interobserver differences. With a residual air flow of 0 to 10 ml/min within two hours after surgery, the chest tubes were removed. When the chest x-ray (2 hours after chest tube removal) showed neither a pneumothorax nor pleural effusion the patients who agreed were sent home. Neverthe-

less we had 2 patients readmitted because of a pneumothorax. There are two possible explanations. The air leak was below the measurable threshold, or more likely that the air leak developed in the days after chest tube removal¹⁵. Nevertheless, the re-admission rate after procedure was low and the late onset pneumothorax might have occurred even though the patient initially admitted for a few days. Before introduction of a digital suction device, we used to see a pneumothorax immediately after chest tube removal due to a missed air leak. This is not the case anymore.

Outpatient VATS procedure could have several advantages. We found a high patient satisfaction as a result of a shorter drainage time and therefore less pain. All patients who went home the same day expressed that would want the next VATS to be performed again in an outpatient setting. Furthermore we observed considerably less postoperative pain when we started the procedure by making pre-incisional local infiltration of the port sites with Bupivacaine rather than to do it after surgery.

The benefit in terms of cost is dependent mainly of the healthcare system. In Switzerland outpatient surgery in this setting is not encouraged since the hospital loses money. Obviously in the long run every healthcare system is ultimately financed by the patient will benefit for shorter hospital stays and consecutive lower costs.

Table III. Comparison of the demographic data between no admitted vs admitted group.

Characteristics of the Sample Population	No re-admission (51 pts) n (%) or mean ± SD	Re-admission (4 pts) n (%) or mean ± SD	p value
Age (mean ± SD)*	61.33 (± 11.65)	64.5(± 14.7)	0.59
Age >/< 65 years**	2/51	2/4	0.85
Male/female**	37/14	3/1	0.70
Active smokers**	27/14	3/1	0.59
Nodular lesions**	46 (90.1%)	4 (100%)	0.67
Interstitial disease**	5 (9.8%)	0 (0%)	0.67
Malignant disease**	23 (45.0%)	3 (75%)	0.26
Side right/left**	33/18	2/2	0.46
Site of main resection**			
Left upper lobe	10 (9.8%)	2 (50%)	0.20
Left lower lobe	8 (9.8%)	0 (0%)	0.52
Right upper lobe	5 (9.8%)	1 (25%)	0.37
Medium lobe	2 (9.8%)	0 (0%)	0.85
Right lower lobe	12 (9.8%)	1 (25%)	0.67
Bilateral lesion**	12 (9.8%)	0 (0%)	0.36
One wedge resection**	34 (66.6%)	3 (75%)	0.60
Two wedge resections	17 (33.4%)	1 (25%)	0.60

*independent sample t test; **Chi square test

We believe that among all the new technical devices we use in thoracic surgery^{16,17} the digital drainage systems is a true step ahead towards improved quality for our patients.

Limitations, Strengths and Future Perspectives

Our study is based on the retrospective analysis of a small group of patients. We therefore have no control group and a relatively small number of patients. The main limitation though is the fact that our inclusion criteria were not well defined. In fact, apart from the patent contraindications they were often based on the surgeon's opinion.

Despite those limitations our analysis shows that outpatient VATS lung wedge resections can be performed.

The next step will be to establish clear inclusion criteria and organize a larger prospective randomized clinical trial.

Conclusions

The chest tube can be safely removed two hours after VATS. In selected patients the outpatient diagnostic VATS wedge lung resection is a new option with very low complication and readmission rate.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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