

Uniportal Versus Needlescopic Video-Assisted Thoracoscopic Surgery for Primary Spontaneous Pneumothorax: A Comparable Study

Jen-Hao Chuang

National Taiwan University Cancer Center

Hsiao-Hsun Hsu

National Taiwan University Hospital

Mong-Wei Lin

National Taiwan University Hospital

Pei-Ming Huang

National Taiwan University Hospital

Shuenn-Wen Kuo

National Taiwan University Hospital

Ke-Cheng Chen (✉ cskchen@gmail.com)

National Taiwan University Hospital

Jin-Shing Chen

National Taiwan University Cancer Center

Research Article

Keywords: Primary spontaneous pneumothorax, thoracic surgery, needlescopic VATS, uniportal VATS

Posted Date: June 9th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-579271/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Objectives:

Primary spontaneous pneumothorax (PSP) is a common disease in young and thin male. Operation has been regarded as definitive treatment for it. However, the operative methods for those patients are under dispute. Our study is aimed to compare the uniportal VATS versus needlescopic VATS for PSP patients in our institute.

Methods:

From July 2013 to December 2017, the patients who underwent video-assisted thoracic surgery for pneumothorax in National Taiwan University Hospital were retrospectively collected. The preoperative condition, surgical results, and postoperative outcomes was analyzed.

Results:

There were 60 patients undergoing needlescopic VATS and 91 undergoing uniportal VATS during the study period. There was no significant difference between the patients who underwent needlescopic VATS and those who underwent uniportal VATS in their demographic and clinical characteristics. The post-operative pain score was significantly lower in the uniportal VATS group compared to the mini VATS group at day 1 (2.65 ± 1.59 vs. 1.74 ± 1.35 , $p = 0.001$).

Conclusion:

We have shown that uniportal VATS is an effective and a safe treatment for PSP patients, and it is comparable to needlescopic VATS. Based on these results, we believe that uniportal VATS using a wound protector can be used as an alternative approach for PSP.

Key Question

What are the clinical results of uniportal versus needlescopic VATS for primary spontaneous pneumothorax?

Introduction

Pneumothorax is defined as the presence of the air in the pleural cavity. Primary spontaneous pneumothorax (PSP) is prone to occur in young, tall, lean men¹. After the first episode, the estimated recurrence rate is 32%, ranging from 17–54%^{2–3}. The optimal management of PSP has been an issue for discussion for years. The American College of Chest physicians (ACCP) and the British Society of Thoracic Surgeons (BSTS)⁴ have published their own guidelines for the management of PSP. Both reports stated that PSP should be treated surgically after the first recurrence, performing a thoracoscopic

bullectomy associated with a procedure for inducing pleural adhesions. Therefore, the surgical approach is considered the best treatment to minimize the risk of recurrence in patients who experienced PSP.

Needlescopic equipment and instruments have been applied to thoracic procedures.⁵ The initial reports suggested that needlescopic VATS was feasible and resulted in better cosmesis and less postoperative pain for PSP patients. In contrast, uniportal VATS technique has shown to be safe and efficient not only for pulmonary resections and biopsies but also for lobectomy.⁶ Besides, uniportal VATS could reduce patients' postoperative pain and paraesthesia and improve patients' satisfaction, concluding that the uniportal VATS technique is a safe, feasible and effective treatment for PSP⁷. However, the comparison between these two methods lacks. In this study, we retrospectively reviewed our experience of needlescopic VATS and uniportal VATS technique to treat PSP.

Materials And Methods

Study design and patients

The medical records of all patients of PSP, and who underwent VATS for treatment of it at National Taiwan University Hospital, a 3,200-bed tertiary medical center, during the period from July 2013 to December 2017 were retrospectively collected. The data included patients in needlescopic and uniportal VATS groups. The preoperative condition, surgical results, and postoperative short-term outcomes was analyzed. The Research Ethics Committee of National Taiwan University Hospital approved this study (approval number: 201803043RINA) and waived the requirement for informed consent due to the study's retrospective nature. It was confirmed that all methods were performed in accordance with the relevant guidelines and regulations.

Surgical techniques

Needlescopic VATS

Under general anesthesia with single lung ventilation, the patients were turned into the lateral decubitus position. After disinfection, a 12 mm port was made at the sixth or seventh intercostal space. Three small skin punctures were made, and mini-ports were inserted for needlescopic instruments. A 10-mm 30 telescope was first inserted to examine the pleural cavity. The inferior mini-port for the needlescope was located at the seventh or eighth intercostal space of the mid-axillary line, one intercostal space lower than the level of the chest tube wound. The two superior mini-ports were located at the fourth and fifth intercostal space of the anterior and posterior axillary lines, respectively.^{5,6}

The inferior mini-port for the needlescope was located at the seventh or eighth intercostal space of the mid-axillary line, one intercostal space lower than the level of the chest tube wound. The two superior mini-ports were located at the fourth and fifth intercostal space of the anterior and posterior axillary lines, respectively. Initially, the 10 mm telescope and two mini-endograspers were used to identify the blebs. When a bleb was identified, it was fixed by mini-endograsper at one of the superior mini-ports. A 3 mm 30

needlescope was introduced at the inferior mini-port to visualize the bleb. The 10-mm telescope was then withdrawn, and a 45 mm endoscopic linear stapler was introduced to resect the bleb. If no air leakage was identified, apical stapling was routinely performed at the most suspicious area. The surgical specimen was retrieved from the chest tube wound. The 10 mm telescope was inserted again to check the stapling line.^{5,6}

Uniportal VATS

After skin preparation, we made a 2.5 cm skin incision in the fifth intercostal of mid/posterior axillary line. A wound protector was applied to the incision without use any trocar. Once lung deflated, a 5-mm, rigid endoscope with 30-degree viewing angle was then inserted to the pleural space to confirm the lesion. An endoscopic grasping instrument and endoscopic stapler were inserted through the same window. Bullectomy and/or blebectomy were operated under direct thoracoscopic vision with endostaplers. Then we completed mechanical pleurodesis by pleural abrasion with scratch pad. After checking air-leak and bleeding, a 20–28 French chest tube was placed in the apex of pleural cavity and the wound was closed in layers⁷.

Data collection and analysis

All continuous values were presented as mean \pm standard deviation. The demographic and clinical data of the different surgical groups were compared with a χ^2 test or Fisher's exact test, as appropriate. All of the analyses were performed with the statistical software package SPSS (SPSS, Inc., Chicago, IL, USA).

Results

Of the 151 subjects included in this study, 60 underwent needlescopic VATS and 91 underwent uniportal VATS. There was no significant difference between the patients who underwent needlescopic VATS and those who underwent uniportal VATS in demographics and clinical characteristics (Table 1). One patient in the uniportal VATS group had bilateral pneumothorax, and thus underwent left upper lobe and right upper lobe pulmonary wedge resection by changing the position. No cases were converted with other surgical methods during operation.

There was no statistically significant difference in surgical outcomes between needlescopic and uniportal VATS (Table 2). All four cases of persistent air leakage were treated successfully with additional pleurodesis so that the chest tube could be removed. One case of massive pleural effusion was treated successfully after prolonged chest tube drainage. The post-operative pain score was significantly lower in the uniportal VATS group compared to the needlescopic VATS group at day 1 (2.65 ± 1.59 vs. 1.74 ± 1.35 , $p = 0.001$). Although there was no significant difference in the use of additional intramuscular analgesia in the two groups both on post-operative 3 days and discharge, the dose was still lower in the uniportal VATS group (0.78 ± 0.94 vs. 0.69 ± 0.98 , $p = 0.545$). Both groups had three cases of recurrent pneumothorax in the during the follow-up period. All cases were treated by re-do VATS that led to

successful re-expansion of the lung. Additional treatment was not indicated as there was no further air leakage.

Discussion

Pneumothorax exists with a disease spectrum, ranging from devastating emergency to asymptomatic minor abnormality.^{8,9} There are lots of innovative treatments proposed in recent decades.^{1–5,7,11–14} Most thoracic surgeons worldwide are well trained to perform VATS bullectomy on patients with PSP, but many inconsistencies have been found in terms of how they perform VATS. Different methods have their individual risks. In most cases, the disease course is not so lethal that recurrence is the main problem. While it is not difficult to drain air from the body using a drain and chest bottle, the major challenge is to prevent reoccurrence.^{15–17} Therefore, the operation target is resuming complete expansion of the lung and prevention of recurrent pneumothorax. Clinically, indications for surgery include ipsilateral or contralateral recurrent episodes; persistent air leaks from chest tube (> 5–7 days) or radiological persistence of pneumothorax after the same period; bilateral pneumothorax; concurrent hemothorax; risk occupation and pregnancy.⁴ Thus, pleurectomy or pleural abrasion by VATS is better tolerated but has a higher recurrence rate (approximately 5%). Our previous study also showed that needlescopic VATS is feasible in the treatment of PSP.³

On the other hand, uniportal VATS has been proposed for innovative minimally invasive approach for surgical management in PSP for many years. In this study, we found the feasibility, complications, and short-term outcomes of needlescopic VATS with those of uniportal VATS procedures are quite similar. Uniportal VATS has the advantageous post-operative pain score while others parameters seem equal and non-inferior.

Conclusion

We have shown that uniportal VATS is an effective and a safe treatment for PSP patients, and it is comparable to needlescopic VATS. Based on these results, we believe that uniportal VATS using a wound protector can be used as an alternative approach for primary spontaneous pneumothorax.

Abbreviations

PSP: primary spontaneous pneumothorax

VATS: Video-assisted Thoracoscopic Surgery

References

1. Tschopp JM, Bintcliffe O, Astoul P et al. ERS task force statement: diagnosis and treatment of primary spontaneous pneumothorax. *Eur Respir J.* 2015;46(2):321-335.

2. Massongo M, Leroy S, Scherpereel A, et al. Outpatient management of primary spontaneous pneumothorax: a prospective study. *Eur Respir J*. 2014;43(2):582-590.
3. Chen JS, Chan WK, Tsai KT, et al. Simple aspiration and drainage and intrapleural minocycline pleurodesis versus simple aspiration and drainage for the initial treatment of primary spontaneous pneumothorax: an open- label, parallel-group, prospective, randomised, controlled trial. *Thorax* 2013;381(9874):1277-1282.
4. Henry M, Arnold T, Harvey J; Pleural Diseases Group, Standards of Care Committee, British Thoracic Society. BTS guidelines for the management of spontaneous pneumo- thorax. *Thorax* 2003;58(Suppl 2):ii39–52.
5. Chang YC, Chen CW, Huang SH, Chen JS. Modified needlescopic video-assisted thoracic surgery for primary sponta-neous pneumothorax: the long-term effects of apical pleurectomy versus pleural abrasion. *Surg Endosc* 2006;20:757–762.
6. Diego Gonzalez-Rivas, Eva Fieira, Maria Delgado, Lucia Mendez, Ricardo Fernandez, Mercedes de la Torre Uniportal video-assisted thoracoscopic lobectomy. *J Thorac Dis*. 2013 Aug; 5(Suppl 3): S234–S245. doi: 10.3978/j.issn.2072-1439.2013.07.30
7. Luis A Berlanga 1, Orlando Gigirey. Uniportal video-assisted thoracic surgery for primary spontaneous pneumothorax using a single-incision laparoscopic surgery port: a feasible and safe procedure. *Surg Endosc*. 2011 Jun;25(6):2044-7. doi: 10.1007/s00464-010-1470-7. Epub 2010 Dec 7.
8. Hyde B, Hyde L. Spontaneous pneumothorax—contrast of the benign idiopathic and the tuberculous types. *Ann Intern Med* 1950;33:1373–1377.
9. Kjærgaard H. Spontaneous pneumothorax in the apparently healthy. *Acta Med Scand Suppl* 1932;43:1–159.
10. Gossot D, Galetta D, Stern JB, et al. Results of thoracoscopic pleural abrasion for primary spontaneous pneumothorax. *Surg Endosc* 2004;18:466–471.
11. Huh U, Kim YD, Cho JS, I H, Lee JG, Lee JH. The effect of thoracoscopic pleurodesis in primary spontaneous pneumothorax: apical parietal pleurectomy versus pleural abrasion. *Korean J Thorac Cardiovasc Surg* 2012;45:316–319.
12. Moreno-Merino S, Congregado M, Gallardo G, et al. Comparative study of talc poudrage versus pleural abrasion for the treatment of primary spontaneous pneumothorax. *Interact Cardiovasc Thorac Surg* 2012;15:81–85.
13. Chen JS, Hsu HH, Huang PM, et al. Thoracoscopic pleurodesis for primary spontaneous pneumothorax with high recurrence risk: a prospective randomized trial. *Ann Surg* 2012;255:440–445.
14. Park JS, Han WS, Kim HK, Choi YS. Pleural abrasion for mechanical pleurodesis in surgery for primary spontaneous pneumothorax: is it effective? *Surg Laparosc Endosc Percutan Tech* 2012;22:62–64.
15. Aihara K, Handa T, Nagai S, et al. Efficacy of blood-patch pleurodesis for secondary spontaneous pneumothorax in interstitial lung disease. *Intern Med* 2011;50:1157–

16. Rena O, Massera F, Papalia E, Della Pona C, Robustellini M, Casadio C. Surgical pleurodesis for Vanderschueren's stage III primary spontaneous pneumothorax. Eur Respir J 2008;31:837–841.
17. Colt HG, Russack V, Chiu Y, et al. A comparison of thoracoscopic talc insufflation, slurry, and mechanical abrasion pleurodesis. Chest 1997;111:442–448.

Tables

Table 1. Demographic and clinical characteristics of study groups of PSP

	Needlescopic VATS (n=60)	Uniportal VATS (n=91)	p Value
Age, mean ± SD, years	20.85 ± 5.90	23.53 ± 8.23	0.03
Male	50	74	
Female	10	17	
BMI	19.22 ± 2.40	19.09 ± 2.46	
Smoking	7	8	0.56
Pneumothorax site			NS
Right	22	39	
Left	37	51	
Bilateral	0	1	
Pre-OP intervention	23	31	NS

BMI = body mass index

Table 2. Surgical outcomes between needlescopic VATS and uniportal VATS for PSP

	Needlescopic VATS (n=60)	Uniportal VATS (n=91)	p Value
Operation time, minutes	55.80 ± 21.93	53.49 ± 20.40	0.51
Hospital stay, days	3.6 ± 1.66	3.25 ± 0.85	0.95
Chest tube drainage days	2.7 ± 1.4	2.35 ± 0.92	0.17
Complications, no. (%)			NS
hemothorax	0	0	
persistent air leak (chemical pleurodesis)	1	3	
Massive pleural effusion	0	1	
Pain score			
Day 0	2.65 ± 1.59	1.74 ± 1.35	0.001
Day 1	1.97 ± 1.20	1.70 ± 0.98	0.16
Day 2	1.54 ± 0.89	1.3 ± 0.84	0.12
Intravenous analgesics	0.78 ± 0.94	0.69 ± 0.98	0.55
Recurrence	3	3	0.78