

Needlescopic-assisted uniportal video-assisted thoracoscopic pulmonary anatomical segmentectomy

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Background: Pulmonary segmentectomy can be an oncologic equivalent of lobectomy for small non-small cell lung cancer. Uniportal video-assisted thoracoscopic surgery (VATS) has recently showed favorable surgical outcomes, but remains technical demanding, especially in a complex procedure like anatomic segmentectomy. This manuscript demonstrates the surgical techniques for uniportal VATS segmentectomies with the assistance of additional needlescopic instruments.

Methods: Data of 22 consecutive patients who underwent 24 needlescopic-assisted uniportal VATS segmentectomies between December 2016 and June 2017 was analyzed.

Results: There were 12 uni-segmentectomies, 10 bi-segmentectomies, and 2 tri-segmentectomies. The mean operation time was 178.3 minutes. The mean duration of chest tube drainage was 5.2 days, and the mean duration of hospital stay was 7.4 days. There were two episodes of major bleeding and one case that required conversion to lobectomy.

Conclusions: Under the assistance of additional needlescopic instruments, segmentectomy can be performed more easily and safely with uniportal VATS.

Keywords: Needlescopic; uniportal VATS; segmentectomy

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Introduction

Sublobar resection has been shown to be an effective alternative approach in the treatment of lung cancer (1-3). Although segmentectomy and wedge resection are grouped as sublobar resections, segmentectomy is more technically challenging than wedge resection, and current evidence suggests that wedge resection is associated with higher local recurrence compared with anatomical segmentectomy (4,5). Furthermore, several recent meta-analyses have shown that segmentectomy can be an oncologic equivalent of lobectomy (6,7). The development of uniportal video-assisted thoracoscopic surgery (VATS) in recent years has greatly changed the preference of thoracic surgeons in major pulmonary resections to segmentectomies. The

potential advantages are less pain, better cosmesis, and direct surgical view for the operator (8,9). However, thoracoscopic anatomical segmentectomy is a complex and time-consuming procedure, and it was generally performed through three or more thoracic incisions, even though some of the experts had reported their experiences (10,11). Needlescopic instruments that are 3 mm in diameter or less are commonly utilized as adjuncts to traditional laparoscopy or single-port laparoscopic surgery and result in almost invisible surgical wounds (12). Needlescopic VATS was developed before uniportal VATS; however, its applications are confined to minor procedures such as sympathectomy for palmar hyperhidrosis and simple lung wedge resections (13-15). Here, we report our experience with thoracoscopic anatomical segmentectomy



Figure 1 Operating room set up.



Figure 2 3.5 mm minilaparoscopy set (Karl Storz Corporation, Tuttlingen, Germany).

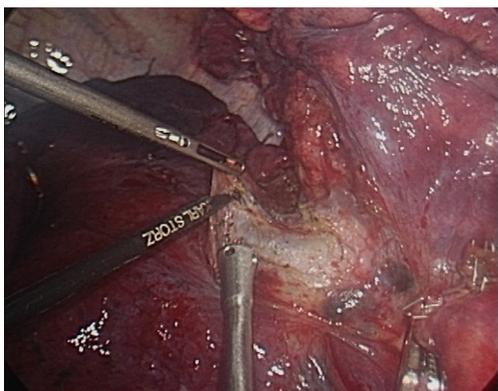


Figure 3 Hilar dissection using four instruments (two instruments through the uniportal incision and two needlescopic instruments).

using the technique of uniportal VATS with the assistance of the additional needlescopic instruments.

Operating room set-up and surgical instruments

The standard set-up of the operating room consisted of two monitors, positioned at the front and back of the patient. The uniportal surgeon is positioned on the ventral side

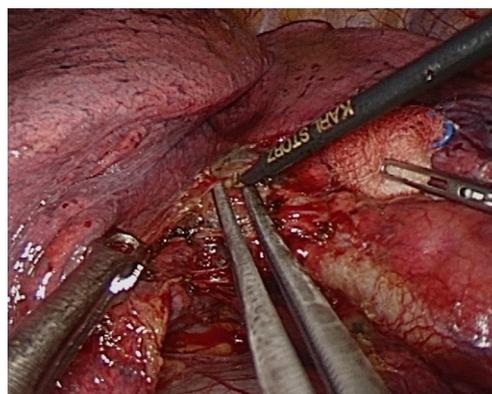


Figure 4 Collaboration between the uniportal surgeon and needlescopic assistant, similar to open surgery.

of the patient with the cameraman and the needlescopic surgeon on the dorsal side (*Figure 1*).

A 10-mm, 30° angled HD video-thoracoscope was used in all cases. Regular uniportal VATS instruments and needlescopic instruments were used (*Figure 2*).

Operative technique

The size and the location of the utility incision are identical to those of regular uniportal VATS. After the uniportal system had been set up, two additional needlescopic ports were made under thoracoscopic guidance. The levels of needlescopic ports should be lower than the uniportal incision to prevent mirror image for the needlescopic surgeon. Similar to uniportal VATS technique, the 30-degree thoracoscopy is inserted in the posterior part of the incision and the instruments are placed below the camera. In the setting of needlescopic-assisted uniportal VATS, the procedure usually begins with hilar dissection. Adequate exposure of the hilar area is achieved by the instrument inserted through the uniportal, such as curve suction and Endo Peanut, and the dissection deep to the perivascular sheath can be easily performed using needlescopic hook electrocautery with countertraction provided by a needlescopic grasper using a two-hand surgical maneuver (*Figure 3*). Segmentectomy follows the principles of pulmonary anatomical resections such as division of segmental veins, segmental arteries, and the lobar segmental bronchus. Dissection around the vascular structures can be efficiently performed with collaboration between the thoracoscopic dissector and needlescopic hook electrocautery, just like in open surgery (*Figure 4*). With

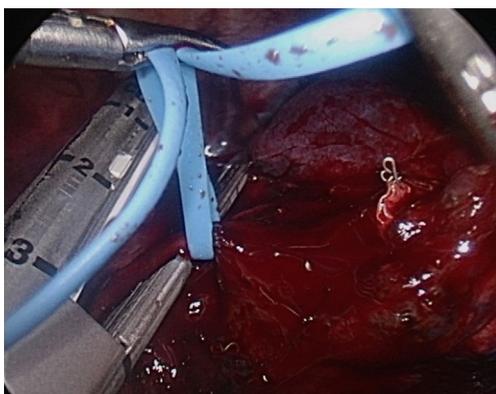


Figure 5 Vascular loops held by needleoscopic instruments during vessel stapling.

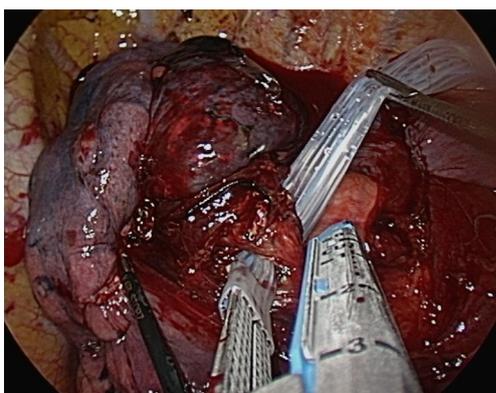


Figure 6 Stapler guided by Penrose drain tube.



Figure 7 Right upper lobe posterior (S2) segmentectomy (16). Available online: <http://www.asvide.com/articles/1711>

the assistance of the needleoscopic instruments, the anvil of endostapler can safely pass through the pulmonary vessels and bronchus in the same way as in multiportal VATS using



Figure 8 Right lower lobe anterior (S8) segmentectomy (17). Available online: <http://www.asvide.com/articles/1712>



Figure 9 Left upper lobe apicoposterior (S1 + S2) segmentectomy (18). Available online: <http://www.asvide.com/articles/1713>

vascular loops (*Figure 5*) or Penrose drain tube guidance (*Figure 6*). After the segmentectomy, radical mediastinal lymphadenectomy completes the procedure and a chest tube is inserted through the uniportal incision.

Video atlas of needleoscopic-assisted uniportal VATS segmentectomy

- (I) Right upper lobe posterior (S2) segmentectomy (*Figure 7*);
- (II) Right lower lobe anterior (S8) segmentectomy (*Figure 8*);
- (III) Left upper lobe apicoposterior (S1 + S2) segmentectomy (*Figure 9*).

Results

From December 2016 to June 2017, 22 consecutive patients

Table 1 Patient's characteristics

Variables	Values (N=24)
Sex (female)	16 (66.7%)
Age (y)	52.0±12.2
Height (m)	159.5±7.1
Weight (kg)	62.2±9.0
BMI (kg/m ²)	24.4±3.3
Smokers	3 (12.5%)
Preoperative hemoglobin (g/dL)	13.8±1.1
FVC (%)	102.1±17.5
FEV ₁ (%)	100.8±18.8
Lesion size (cm)	1.2±0.5
ASA physical status class	
I	9 (37.5%)
II	5 (20.8%)
III	10 (41.7%)

BMI, body mass index; FVC, forced vital capacity; FEV₁, forced expiratory volume in one second; ASA, American Society of Anesthesiologists.

underwent 24 segmentectomies for malignant or benign pulmonary diseases. Eight patients were male and 14 were female. Within the group, two female patients underwent bilateral thoroscopic surgeries and the other patients underwent unilateral surgeries; their preoperative characteristics are reported in *Table 1*. The mean age was 52 years, and the median body mass index was 24.4 kg/m². The median tumor size was 1.2 cm. The mean forced vital capacity was 102.1% of predicted and the mean forced expiratory volume in 1 second was 100.8% of predicted. At the time of the procedure, the American Society of Anesthesiologists Physical Status Classification grade was class 1 in 9 patients, class 2 in 5, and class 3 in 10. The operative results are reported in *Table 2*. There were 12 uni-segmentectomies, 10 bi-segmentectomies, and 2 tri-segmentectomies. The mean operation time was 178.3 minutes. The mean duration of chest tube drainage was 5.2 days, and the mean duration of hospital stay was 7.4 days. There were two episodes of major bleeding which were successfully controlled without conversion to thoracotomy or conventional VATS, and one case required conversion to lobectomy due to unidentifiable lesion in the resected segment. Of the 24 nodules evaluated, 18 were

Table 2 Operative results

Variables	Values (N=24)
Uni-segmentectomy	
RS1	1
RS2	3
RS3	1
RS5	1
RS6	1
RS8	2
LS3	2
LS6	1
Bi-segmentectomy	
RS1+2	2
RS2+3	1
RS9+10	1
LS1+2	5
LS4+5	1
Tri-segmentectomy	
LS1+2+3	2
Operation time (min)	178.3±65.6
Dissected lymph node numbers	
N1	4.2±2.8
N2	7.3±5.6
Chest tube drainage duration (d)	5.2±1.5
Hospital stay (d)	7.4±1.9
Complication	
Major bleeding	2 (8.3%)
Convert to lobectomy	1 (4.2%)

RS, right segment; LS, left segment.

malignant and 6 were benign lesions (*Table 3*). Pathological examination showed that adenocarcinoma was the most common malignancy.

Conclusions

We have presented our experience with needlescopic-assisted uniportal VATS segmentectomy, which is an extension of uniportal VATS. Based on the technique of

Table 3 Pathologic results

Variables	Values (N=24)
Malignancy	
Primary lung adenocarcinoma	15
Carcinoid tumor	2
Metastatic lung cancer	1
Benign disease	
Tuberculous granuloma	3
Cryptococcus	1
Chronic inflammation	2

uniportal VATS, the assistance of additional needlescopic instruments was expected to make the procedure easier and safer without compromising the advantages of uniportal VATS, and the surgery can be performed with better collaboration between the uniportal surgeon and surgical assistant.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The study has been approved by the Research Ethics Committee of National Taiwan University Hospital, Hsin-Chu Branch (approval number: 106-032-E).

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