RECENT ADVANCES IN UNIPORTAL VATS

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The most dangerous phrase in the language is "we've always done it this way."

Innovation

"There's a way to do it better—find it."
– Thomas Edison
Video-Assisted Thoracic Surgery Lobectomy: Experience With 1,100 Cases

Robert J. McKenna, Jr, MD, Ward Houck, MD, and Clark Beeman Fuller, MD
Cedars Sinai Medical Center, Los Angeles, California

Background. Although many video-assisted thoracic surgery (VATS) lobectomies have been performed over the 12 years since the first VATS lobectomy, controversies about the procedure remain regarding the safety and associated morbidity and mortality of that procedure. This series is reviewed to assess these issues.

Methods. Between 1992 and 2004, we performed 1,100 VATS lobectomies in 595 women (54.1%) and 505 men (45.9%), with a mean age of 71.2 years. Diagnoses were as follows: benign disease (53), pulmonary metastases (27), lymphoma (5), and lung cancer (1,015). Of the primary lung cancers, 641 (63.1%) were adenocarcinoma. With visualization on a monitor, anatomic hilar dissection and lymph node sampling or dissection were performed, primarily through a 5-cm incision without spreading the ribs.

Results. There were 9 deaths (0.8%), and none was intraoperative or due to bleeding; 932 patients had no postoperative complications (84.7%). Blood transfusion was required in 45 of 1,100 patients (4.1%). Length of stay was median 3 days (mean, 4.78). One hundred eighty patients (20%) were discharged on postoperative day 1 or 2. Conversion to a thoracotomy occurred in 28 patients (2.5%). Recurrence developed in the incisions in 5 patients (0.57%). In 2003, 89% of 224 lobectomies were performed with VATS.

Conclusions. VATS lobectomy with anatomic dissection can be performed with low morbidity and mortality rates. The risk of intraoperative bleeding or recurrence in an incision seems minimal.

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Learning VATS?

Where the MAGIC happens!

Your Comfort Zone
Begining (2007)
* 6-8 vsrs per mammogram
North Carolina (T. Dan{

- Dan to 2 parts
- On to 3 week

Double port technique
First Uniportal lobectomy
April 2009
First reported Uniportal VATS lobectomy
June 2010
Video-assisted thoracic surgery lobectomy: 3-year initial experience with 200 cases

Diego Gonzalez*, Mercedes de la Torre, Marina Paradela, Ricardo Fernandez, Maria Delgado, Jose Garcia, Eva Fleira, Lucia Mendez

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Abstract

Objective: To analyse the evolution of the video-assisted thoracoscopic (VATS) approach for lobectomy and results during the first 3 years of program. Methods: From 1st July-2007 to 31st July-2010 we carried out 200 lobectomies by VATS. In February 2009 we started performing VATS lobectomies with only 2 incisions. We have analyzed both annual and overall outcomes regarding type of approach, conversion rate, surgical time, lymphadenectomy and overall survival. Results: Distribution of the cases per year were as follows: first-year 32, second-year 65, third-year 103. Overall conversion rate was 14.5% (first-year 25%, second-year 28%, third-year 7.8%; p = 0.017). Surgical approach was: 4 ports (1 case), 3 ports (99 cases, 100% in first-year), 2 ports (99 cases, 80% in third-year), single-port (1 case, third-year) Mean surgical time in successful VATS was 193.8 min (210.8 first-year, 207.9 second-year, 181.1 third-year; p = 0.011), mean number of lymph nodes were 11.9 (9.3 first-year, 10.1 second-year, 13.9 third-year; p = 0.003) and mean explored stations was 4.2 (3.6 first-year, 3.8 second-year, 4.5 third-year; p < 0.001). Globally median chest tube duration was 3 days. Median length of stay was 4 days. The disease-free survival at 30 months was 85% for Stage I patients and 62% for non-stage I patients. Conclusions: As we gain more experience over time, with more cases performed each year and less invasive approaches, results improve in terms of less surgical time and more extended lymphadenectomies. Furthermore, we have observed a clear evolution in our surgical approach to a less invasive 2-port approach. In selected cases we have implemented the single-port lobectomy.

Keywords: Thoracoscopy/VATS; Lobectomy; Lung cancer surgery; Surgical approach
“In our experience, this technique is possible for lower lobes. For upper lobes, the hilar dissection is possible via one incision but there are difficulties stapling the upper vein, mediastinal trunk and the bronchus. Probably, the development of new technologies (angled optics, angled and curved staplers) will lead to single-port upper lobectomies becoming possible in experienced VATS groups”
Think Uniportal!
Upper lobes
Single-incision video-assisted thoracoscopic lobectomy: Initial results

Diego Gonzalez-Rivas, MD, Marina Paradela, MD, Eva Fieira, MD, and Carlos Velasco, Coruña, Spain

Video-assisted thoracoscopic surgery (VATS) was introduced nearly 2 decades ago and has experienced an exponential increase for lung cancer treatment. The standard approach is performed through three incisions, including a utility incision of about 3 to 5 cm. However, recent publications have highlighted the potential benefits of single-port VATS lobectomy. We report our experience with initial results of this single-port VATS lobectomy.

In our experience, especially in the upper lobes, we have favored the use of staplers to divide the lung parenchyma and achieve an anatomical lobectomy. In the lower lobes, we have favored the use of a surgical stapler to divide the upper lobe vein and prevent intraoperative bleeding. Digital palpation confirmed the lobectomy lobes that were too close to the hilum and retraction of the camera to facilitate the dissection of the lower lobe. The bronchus was divided and the lobe was resected. The thoracic cavity was inspected for any remaining pulmonary segments.

2. Clinical Case

A 74-year-old male with a history of smoking presented with left lower lobe pneumonia. Computed tomography (CT) scan showed a 4-cm nodule in the left lower lobe. A single-port VATS lobectomy was performed under general anesthesia.

3. Surgical technique

The patient was placed in a right-lateral decubitus position. A 4-cm incision was made in the fifth intercostal space. A single-port VATS lobectomy was performed using a video-assisted thoracoscopic system (VATS). The lung was retracted using a retractor, and the bronchus was divided using a surgical stapler. The lobe was then removed using a stapler. The thoracic cavity was inspected for any remaining pulmonary segments.

4. Discussion

There is no standardized technique for VATS lobectomy, although most centres use a utility incision of about 3 to 5 cm and a single-port VATS technique. Single-port VATS lobectomy allows for a faster recovery time and fewer complications compared to traditional VATS lobectomy. This technique also reduces the risk of surgical site infections and decreases the rate of postoperative pain.

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Discussion

Over recent years, there have been many advances in application of VATS to lung cancer treatment. Despite this
Thoracoscopic lobectomy through a single incision

Diego Gonzalez-Rivas\(^a, b, c\), Ricardo Fernandez\(^a, b\), Mercedes de la Torre\(^a, b\) and Antonio E. Martin-Ucar\(^c\)

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\(^b\)Department of Thoracic Surgery, Coruña University Hospital, Coruña, Spain
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Minimally Invasive Thoracic and Cardiac Surgery

Textbook and Atlas

with a video-assisted thoracoscopic approach, with no rib spreading.

The surgeon and the assistant must be placed in front of the patient in order to have the same thoracoscopic vision during all steps of the procedure and be more coordinated with the movements (Fig. 9.1).

The camera must be of 30° in order to enable us to achieve a panoramic view (10 mm scope high definition preferred). Instruments must preferably be long and curved to allow the insertion of 3 or 4 instruments simultaneously.

Optimal exposure of the lung is key in order to facilitate the dissection of the structures and to avoid instrument malposition. Even though the

9.3 Surgical Technique

9.3.1 Lower Lobectomies

Under general anesthesia and double lumen intubation, the patient is placed in a lateral decubitus position as usual for a conventional VATS. A 4-cm incision with no rib spreading is made in
Advanced cases

Single-Incision Thorascopic Right Upper Lobectomy With Chest Wall Resection by Posterior Approach

Diego Gonzalez-Rivas, MD, Ricardo Fernandez, MD, Eva Feire, MD, and Lucia Mendez, MD

Abstract: Lobectomy requiring chest wall resection is usually performed by thoracotomy, but thanks to the advances in the field of thorascopic surgery, this procedure can be performed by video-assisted thorascoscopic surgery (VATS). Recent improvements in surgical devices and previous VATS experience have allowed this complex surgery for advanced stages to be undertaken safely. Most of the thorascoscopic lobectomies with rib resection are performed using three to four incisions. We report a different minimally invasive technique for chest wall resection (minimally invasive posterior approach) and VATS upper right lobectomy (single-incision anterior approach).

Key Words: Single-port VATS lobectomy, Chest wall resection, Rib involvement, Thorascoscopic approach, Chemotherapy.

CASE REPORT

SURGICAL TECHNIQUE

The patient was placed in left lateral decubitus position. A video-assisted thorascoscopic surgery (VATS) approach through a single 4-cm incision was done in the fifth intercostal space with no rib spreading. Assessment of the RUL detected chest wall involvement, and a 4-cm posterior subcostal incision was performed to resect the fourth and the fifth posterior rib under anterior thorascoscopic vision (Video 1, available online at http://links.lww.com/INOVA/A26). After the chest wall resection, a right upper lobectomy with complete lymph node dissection was performed through an anterior single-incision approach. The wounds were closed with thorascoscopic sutures (probably because of chemotherapy), but the dissection was performed successfully by single-incision approach (Video 2, available online at http://links.lww.com/INOVA/A26). Because of the localization of the chest wall resection, a muscle flap

Uniportal video-assisted thorascoscopic bronchial sleeve lobectomy: First report

Diego Gonzalez-Rivas, MD, FECTS, Ricardo Fernandez, MD, Eva Feire, MD, and LazDivina Reina, MD, Cornell, Spain

Video clip is available online.

Thoracotomy is the traditional way to perform a bronchial sleeve lobectomy, but it can also be performed by video-assisted thoracic surgery (VATS). Most of the complex resections use 2 to 4 incisions, but the surgery can be done using only 1 incision. We report on uniportal VATS sleeve resection.

CLINICAL SUMMARY

A carcinoma in the right upper lobe with bronchial occlusion and distal pneumonitis (Figure 1, A) was diagnosed in a 55-year-old man. After the induction treatment (cisplatin-based therapy), VATS was the proposed approach for the patient (Figure 2, B). We placed the patient in a left lateral decubitus position. The patient had a VATS approach through a 3-cm incision in the fifth intercostal space with no rib spreading (no soft tissue retractor and no direct visualization). A complete paratracheal and subcarinal lymph node dissection was initially undertaken. We placed the camera in the posterior portion of the incision, with instruments working below. We performed a right upper lobectomy, leaving the division of the bronchus as the last step of the procedure. We mobilized the interlobar artery to expose the bronchus and then tied the angiojets vein. We made circumferential cuts to the mainstem bronchus and the intermediate bronchus with a knife on a long handle and scissors, removed the lobe, and divided the pulmonary ligament (Video 1).

We started the end-to-end anastomosis with a posterior stitch in the cartilaginous-membranous junction to help approximate the intermediate and mainstem broncho and used it for continuous membranous sutures (Video 2). We placed a row of 3X3 interrupted absorbable sutures at the posterior and medial portion of the bronchial cartilage with the help of an endoscopic knot-pusher. While placing the sutures, we tied the knots. We used continuous suture to close the membranous bronchus (from posterior to anterior). We then placed an interrupted suture in the anterior junction and tied it to the end of the running suture on the membranous wall. We finished by using interrupted sutures for the anterior cartilaginous portion (Video 2). We did not use any tissue flaps to protect the anastomosis. We placed a single chest

Left lower sleeve lobectomy by uniportal video-assisted thorascoscopic approach

Diego Gonzalez-Rivas, Maria Delgado, Eva Feire and Oscar Pato

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Abstract

Endobronchial tumours requiring sleeve resection have been usually considered a contraindication for video-assisted thorascoscopic surgery (VATS). However, with new technical advances and the experience gained in VATS, sleeve lobectomy has been performed by thorascoscopic in experienced VATS centres. Right-sided sleeve anastomoses are easier to perform by VATS than left-sided ones because of the presence of the pulmonary artery and aortic arch on the left side. Most surgeons use a 3 to 4 incision VATS technique for sleeve anastomosis but the surgery can be performed by using only one incision. This is the first report of a left-sided sleeve lobectomy by uniportal approach.

Keywords: Sleeve lobectomy - Thorascoscopy/video-assisted thoracic surgery - Minimally invasive surgery - Lobectomy - Lung cancer
Uniportal VATS

Sleeve Resection 2013

Pneumonectomy 2012

Segmentectomy 2012
Lobectomy 2011

Pericardial Window & Mediastinal LN bx 2006
Pleurodesis 2005
Wedge resection 2004
Pleural diseases 2003
Sympathectomy 2002

No limits

Unisurgeon surgery 2016
Carinal resections 2015
Subxiphoid resections 2015
Non intubated surgery 2014
Double sleeve 2014
Uniportal (single-incision) VATS surgery
“Avoiding the trocar improves the instrumentation and minimizes the compression of the intercostal nerve”

Dr. Gonzalez-Rivas
Evolution in technique
Why to change?
Small vessels- Click aV-Grena-45 degree
Published in journals, atlas, textbook, etc

Data and survival
Uniportal Video-Assisted Thoracoscopic Lobectomy: Two Years of Experience

Diego Gonzalez-Rivas, MD, Marina Paradela, MD, Ricardo Fernandez, MD, Maria Delgado, MD, Eva Fieira, MD, Lucía Mendez, MD, Carlos Velasco, MD, and Mercedes de la Torre, MD

Department of Thoracic Surgery, Minimally Invasive Thoracic Surgery Unit (UCTMI), and Department of Cardiac Surgery, Coruña University Hospital, Coruña, Spain

Background. A video-assisted thoracoscopic approach to lobectomy varies among surgeons. Typically, 3 to 4 incisions are made. Our approach has evolved from a 3-port to a 2-port approach to a single 4- to 5-cm incision with no rib spreading. We report results with single-incision video-assisted thoracic major pulmonary resections during our first 2 years of experience.

Methods. In June 2010, we began performing video-assisted thoracoscopic lobectomies through a uniportal approach (no rib spreading). By July 12, 2012, 102 patients had undergone this single-incision approach.

Results. Of 102 attempted major resections, 97 were successfully completed with a single incision (operations in 3 patients were converted to open surgery and 2 patients needed 1 additional incision). Five uniportal pneumonectomies were not included in the study. We have analyzed early outcomes of successful uniportal lobectomies (92 patients studied). Right upper lobectomy was the most frequent resection (28 cases). Mean surgical time was 154.1 ± 46 minutes (range, 60–310 minutes), mean number of lymph nodes was 14.5 ± 7 (range, 5–38 nodes), and mean number of explored nodal stations was 4.6 ± 1.2 (range, 3–8 stations). The mean tumor size was 2.8 ± 1.5 cm (0–6.5 cm). The median duration of time a chest tube was in place was 2 days and the median length of hospital stay was 3 days. There were complications in 14 patients; no postoperative 30-day mortality was reported.

Conclusions. Single-incision video-assisted thoracoscopic anatomic resection is a feasible and safe procedure with good perioperative results, especially when performed by surgeons experienced with the double-port technique and anterior thoracotomy.

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Stage IA-Overall survival

![Graph showing survival probability over time](image)

<table>
<thead>
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<th>Probability</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>4 years</th>
<th>5 years</th>
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<td>96.3%</td>
<td>96.3%</td>
<td>96.3%</td>
<td>89.4%</td>
<td>89.4%</td>
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<td>Uniportal patients</td>
<td>Multiportal patients</td>
<td>Study design</td>
<td>Operation</td>
<td>Pain &amp; Morbidity</td>
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<td>McElnay et al</td>
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<td>95</td>
<td>Retrospective Observational</td>
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<td>• Analgesic use – ND</td>
<td>• Complications – ND</td>
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<td>Propensity matched</td>
<td>• Operative time – Uniportal faster</td>
<td>• Complications – ND</td>
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<td></td>
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<td>49</td>
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<td>• Pain score – Uniportal lower</td>
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<td>• Blood loss – ND</td>
<td>• Complications – ND</td>
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<tr>
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<td>342</td>
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<td>• Pain score – Uniportal lower</td>
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<td>• Blood loss – ND</td>
<td>• Analgesic use – Uniportal less</td>
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<td>100</td>
<td>100</td>
<td>Propensity matched</td>
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<td>• Complications – ND</td>
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<td>Mu et al</td>
<td>47</td>
<td>47</td>
<td>Propensity matched</td>
<td>• Operative time – ND</td>
<td>• Complications – ND</td>
</tr>
</tbody>
</table>

Abbreviations used: ND = no difference; CPK_max = maximum postop level of creatine phosphokinase; CRP_max = maximum postop level of C-reactive protein
### Operation

**Single-incision Versus Multiple-incision Thoracoscopic Lobectomy and Segmentectomy**

_A Propensity-matched Analysis_

_Bing-Yen Wang, MD,*†‡ Chao-Yu Liu, MD,*‡§ Po-Kuei Hsu, MD,‡§ Chih-Shiun Shih, MD,* and Chia-Chuan Liu, MD*_

**Transition from a multiport technique to a single-port technique for lung cancer surgery: is lymph node dissection inferior using the single-port technique?**

_Chia-Chuan Liu*, Chih-Shiun Shih*, Nicolas Pennarun* and Chih-Tao Chengbcd*

<table>
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<tr>
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<th>Uniportal VATS</th>
<th>Conventional VATS</th>
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<td><strong>Operation times (mins)</strong></td>
<td>170</td>
<td>191</td>
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<td></td>
<td>179</td>
<td>208</td>
</tr>
<tr>
<td><strong>Blood loss (ml)</strong></td>
<td>53</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>78</td>
</tr>
<tr>
<td><strong>Nodes dissected</strong></td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>25</td>
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Preliminary results of single-port versus triple-port complete thoracoscopic lobectomy for non-small cell lung cancer


<table>
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<tr>
<th>Parameters</th>
<th>Single-port group (n=33)</th>
<th>Triple-port group (n=49)</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>Operation time (min)*</td>
<td>181.3±27.5</td>
<td>149.5±30.9</td>
<td>0.007</td>
</tr>
<tr>
<td>Intraoperative blood loss (mL)</td>
<td>90.6±49.3</td>
<td>79.5±45.2</td>
<td>0.840</td>
</tr>
<tr>
<td>Total lymph node harvest</td>
<td>23.6±11.2</td>
<td>25.4±7.3</td>
<td>0.737</td>
</tr>
<tr>
<td>Positive lymph node</td>
<td>1.5±3.1</td>
<td>1.9±4.9</td>
<td>0.971</td>
</tr>
<tr>
<td>Total mediastinal lymph node harvest</td>
<td>16.2±9.2</td>
<td>17.2±6.5</td>
<td>0.731</td>
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<tr>
<td>Dissection of mediastinal lymph node groups</td>
<td>4.4±1.0</td>
<td>4.4±0.8</td>
<td>0.637</td>
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</table>
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<td>90.6±49.3</td>
<td>79.5±45.2</td>
<td>0.840</td>
</tr>
<tr>
<td>Chest drainage duration (d)</td>
<td>4.0±1.5</td>
<td>5.4±3.7</td>
<td>0.256</td>
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<tr>
<td>POP-VAS</td>
<td>3.6±0.7</td>
<td>5.5±1.0</td>
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<tr>
<td>Postoperative hospital stay (d)</td>
<td>6.9±4.0</td>
<td>7.2±3.5</td>
<td>0.631</td>
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* Ann Transl Med 2015;3(7):92
Pain

Single-incision thoracoscopic surgery and conventional video-assisted thoracoscopic surgery: a retrospective comparative study of perioperative clinical outcomes†

Kyoji Hirai*, Shingo Takeuchi* and Jitsuo Usuda*

European Journal of Cardio-Thoracic Surgery 49 (2016) i37–i41

The number of days used analgesic agents for a month after surgery

Analgesic agents
- NSAIDS
- Pregabalin
- Tramadol hydrochloride

NRS evaluation

day

POD 3  P
Transition from a multiport technique to a single-port technique for lung cancer surgery: is lymph node dissection inferior using the single-port technique? 

Chia-Chuan Liu, Chih-Shiun Shih, Nicolas Pennarun and Chih-Tao Cheng

Table 2: Surgical outcomes by type of surgery (lobectomy and segmentectomy) and number of ports (single/multiple) (n = 538)

<table>
<thead>
<tr>
<th>Outcome variables</th>
<th>Lobectomy</th>
<th></th>
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<th></th>
<th>Segmentectomy</th>
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<td>Single port</td>
<td>Multiport</td>
<td>P-value</td>
<td></td>
<td>Single port</td>
<td>Multiport</td>
<td>P-value</td>
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<tr>
<td></td>
<td>n = 100</td>
<td>n = 342</td>
<td></td>
<td></td>
<td>n = 49</td>
<td>n = 47</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
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<td></td>
<td></td>
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<td>Total dissected lymph node number</td>
<td>28.47 ± 11.77</td>
<td>25.23 ± 11.30</td>
<td>0.013</td>
<td></td>
<td>19.47 ± 10.79</td>
<td>17.91 ± 10.28</td>
<td>0.472</td>
</tr>
<tr>
<td>Blood loss</td>
<td>55.68 ± 52.81</td>
<td>78.22 ± 84.99</td>
<td>0.001</td>
<td></td>
<td>63.88 ± 79.60</td>
<td>59.36 ± 50.23</td>
<td>0.739</td>
</tr>
<tr>
<td>Hospital stay</td>
<td>5.96 ± 1.69</td>
<td>6.80 ± 3.56</td>
<td>0.001</td>
<td></td>
<td>5.76 ± 1.98</td>
<td>6.83 ± 2.21</td>
<td>0.014</td>
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<tr>
<td>Length of wound</td>
<td>3.92 ± 1.81</td>
<td>4.70 ± 0.77</td>
<td>&lt;0.001</td>
<td></td>
<td>3.66 ± 0.77</td>
<td>4.50 ± 0.56</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Operative time</td>
<td>2.99 ± 0.87</td>
<td>3.47 ± 1.06</td>
<td>&lt;0.001</td>
<td></td>
<td>3.34 ± 0.93</td>
<td>3.45 ± 0.92</td>
<td>0.542</td>
</tr>
<tr>
<td>Residual tumour condition (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R0</td>
<td>98 (22.8)</td>
<td>331 (77.2)</td>
<td></td>
<td></td>
<td>48 (52.7)</td>
<td>43 (47.3)</td>
<td></td>
</tr>
<tr>
<td>Microscopic residual tumour</td>
<td>2 (16.7)</td>
<td>10 (83.3)</td>
<td></td>
<td></td>
<td>1 (25.0)</td>
<td>3 (75.0)</td>
<td></td>
</tr>
<tr>
<td>Macroscopic residual tumour</td>
<td>0 (0.0)</td>
<td>1 (100.0)</td>
<td></td>
<td></td>
<td>0 (0.0)</td>
<td>1 (100.0)</td>
<td></td>
</tr>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>92 (92.0)</td>
<td>295 (86.3)</td>
<td></td>
<td></td>
<td>46 (93.9)</td>
<td>39 (83.0)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8 (8.0)</td>
<td>47 (13.7)</td>
<td></td>
<td></td>
<td>3 (6.1)</td>
<td>8 (17.0)</td>
<td></td>
</tr>
</tbody>
</table>

SD: standard deviation. P values less than 0.05 were marked in bold.
# Recovery

## A Matched Comparison Study of Uniportal Versus Triportal Thoracoscopic Lobectomy and Sublobectomy for Early-stage Nonsmall Cell Lung Cancer

Ju-Wei Mu, Shu-Geng Gao, Qi Xue, Jun Zhao, Ning Li, Kun Yang, Kai Su, Zhu-Yang Yuan, Jie He

Department of Thoracic Surgery, Cancer Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing 100021, China

### Table 2: Short-term outcomes of patients after thoracoscopic lobectomy or sublobectomy

<table>
<thead>
<tr>
<th>Perioperative data</th>
<th>Uniportal (n = 58)</th>
<th>Triportal (n = 347)</th>
<th>P</th>
<th>Uniportal (n = 47)</th>
<th>Triportal (n = 47)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time (min)</td>
<td>138.83 ± 63.63</td>
<td>135.62 ± 55.51</td>
<td>0.701</td>
<td>144.95 ± 65.81</td>
<td>130.91 ± 46.88</td>
<td>0.237</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>73.58 ± 51.52</td>
<td>74.08 ± 64.53</td>
<td>0.958</td>
<td>79.76 ± 56.37</td>
<td>72.77 ± 28.49</td>
<td>0.450</td>
</tr>
<tr>
<td>Lymph nodes retrieved</td>
<td>7.02 ± 8.60</td>
<td>13.34 ± 9.26</td>
<td>&lt;0.001</td>
<td>7.83 ± 7.86</td>
<td>7.81 ± 7.99</td>
<td>0.987</td>
</tr>
<tr>
<td>Number of lymph nodes stations</td>
<td>4 ± 1</td>
<td>6 ± 1</td>
<td>&lt;0.001</td>
<td>5 ± 1</td>
<td>5 ± 2</td>
<td>1.000</td>
</tr>
<tr>
<td>Conversion to thoracotomy, n (%)</td>
<td>2 (3.4)</td>
<td>8 (2.3)</td>
<td>0.950</td>
<td>1 (2.1)</td>
<td>1 (2.1)</td>
<td>1.000</td>
</tr>
<tr>
<td>Postoperative hospital stay (day)</td>
<td><strong>6.54 ± 3.84</strong></td>
<td><strong>6.29 ± 2.59</strong></td>
<td>0.547</td>
<td><strong>6.83 ± 4.17</strong></td>
<td><strong>5.42 ± 1.86</strong></td>
<td><strong>0.036</strong></td>
</tr>
<tr>
<td>Duration of chest tube (day)</td>
<td>5.02 ± 1.92</td>
<td>5.25 ± 2.16</td>
<td>0.471</td>
<td>5.17 ± 2.09</td>
<td>4.56 ± 1.71</td>
<td>0.125</td>
</tr>
<tr>
<td>Overall complication, n (%)</td>
<td>6 (10.3)</td>
<td>33 (9.5)</td>
<td>0.842</td>
<td>4 (8.5)</td>
<td>5 (10.6)</td>
<td>1.000</td>
</tr>
<tr>
<td>Pulmonary complications, n (%)</td>
<td>3 (5.1)</td>
<td>14 (4.0)</td>
<td>0.963</td>
<td>2 (4.2)</td>
<td>2 (4.2)</td>
<td>1.000</td>
</tr>
<tr>
<td>Atelectasis</td>
<td>0 (0)</td>
<td>4 (1.2)</td>
<td></td>
<td>0 (0)</td>
<td>1 (2.1)</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2 (3.4)</td>
<td>5 (1.4)</td>
<td></td>
<td>1 (2.1)</td>
<td>1 (2.1)</td>
<td></td>
</tr>
<tr>
<td>Air leak &gt;7 days</td>
<td>1 (1.7)</td>
<td>5 (1.4)</td>
<td></td>
<td>1 (2.1)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Nonpulmonary complications, n (%)</td>
<td>3 (5.1)</td>
<td>19 (5.5)</td>
<td>0.827</td>
<td>2 (4.2)</td>
<td>3 (6.3)</td>
<td>1.000</td>
</tr>
<tr>
<td>Reoperation</td>
<td>0 (0)</td>
<td>4 (1.2)</td>
<td></td>
<td>0 (0)</td>
<td>1 (2.1)</td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>3 (5.1)</td>
<td>15 (4.3)</td>
<td></td>
<td>2 (4.2)</td>
<td>2 (4.2)</td>
<td></td>
</tr>
</tbody>
</table>

Midterm outcomes of single port thoracoscopic surgery for major pulmonary resection

Kook Nam Han1,2,*, Hyun Koo Kim1,2,*, Young Ho Choi1,2,*
1 Department of Thoracic and Cardiovascular Surgery, Korea University Guro Hospital, Seoul, Republic of Korea, 2 Department of Thoracic and Cardiovascular Surgery, Korea University College of Medicine, Seoul, Republic of Korea
* These authors contributed equally to this work.
* kinhynkoo@korea.ac.kr

Abstract

Introduction
Single-port thoracoscopic surgery has widened the current minimally invasive surgical techniques toward more less invasive procedures in terms of reducing the number of incisions. However, the current status of oncologic outcome with this technique is not well known for lung cancer surgery. The purpose of this study is to evaluate the oncologic outcomes in early stage lung cancer for impact of the survival outcomes with our experience of conversion to a single-port approach from the conventional three-port approach.

Materials and methods
Retrospective data of patients who underwent thoracoscopic major lung resection for non-small cell lung cancer between January 2006 and June 2015 were analyzed. Patients' characteristics, perioperative outcomes, pathologic result, and postoperative follow-up data of thoracoscopic surgery were reviewed and surgical outcomes were compared between conventional three-port (n = 168), two-port (n = 68), and single-port thoracoscopic surgery (n = 203).

Results
Of the 203 single-port thoracoscopic surgeries, we performed 167 single-port thoracoscopic lobectomy and mediastinal lymph node dissections. During the learning period of each thoracoscopic approach, the mean operation time for single-port thoracoscopic surgery (189 ±62 min) was not significantly different from those of two-port (175±46 min) and three-port (195±75 min) thoracoscopic lobectomy (p = 0.165). Perioperative outcomes including drain

* * *

Log-rank p-value

% recurrence free survival

100 91.6 84.9 79.9 77.2 75.6
100 95.9 90.7 87.5 83.5 79.5
100 94.9 89.9 79.9 66 56

No. at risk

Three-port
Two-port
Single-port

106 106 106
73 83 73
51 25 25
12 12 12
0 0 0

% survival

100 94.4 93.8 87.3 84.6 81.7
100 96.7 93.7 88.5 84.4 81.7
100 94.9 94.9 93.2 93.2 89.7

Log-rank p-value

Single vs Three-port 0.379
Single vs Two-port 0.260

No. at risk

Three-port
Two-port
Single-port

88 88 88
93 25 25
12 12 12
0 0 0


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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

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Comparison of survival between lung cancer patients receiving single or multiple-incision thoracoscopic surgery

Chia-Chuan Liu1, Bing-Yen Wang2,3,4, Chih-Shiun Shih1, Nicolas Pennarun5, Lay-Chin Lin5, Shi-Ying Gao5, Chih-Tao Cheng5,6

1Division of Thoracic Surgery, Department of Surgery, Koo Foundation Sun Yat-Sen Cancer Center, Taipei; 2Division of Thoracic Surgery, Department of Surgery, Changhua Christian Hospital and Chung Shan Medical University, Taichung; 3School of Medicine, Kaohsiung Medical University, Kaohsiung; 4Institute of Genomics and Bioinformatics, National Chung Hsing University, Taichung; 5Department of Medical Research, Koo Foundation Sun Yat-Sen Cancer Center, Taipei; 6Department of Psychology and Social Work, National Defense University, Taipei

Contributions: (I) Conceptualization and design: BY Wang, CT Cheng; (II) Administrative support: CC Liu; (III) Provision of study materials or patients: CS Shih; (IV) Collection and assembly of data: N Pennarun; (V) Data analysis and interpretation: LC Lin; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

*The authors contributed equally to this work.

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Background: The effect of single-incision thoracoscopic surgery for lung cancer on long-term survival is unknown and no studies have investigated whether there are differences in survival between single and multiple incision approaches. We aimed to compare long-term overall survival and disease-free survival of patients who underwent single-incision thoracoscopic surgery with those who received multiple-incision thoracoscopic surgery for lung cancer.

Methods: We retrospectively analyzed 532 patients with lung cancer who underwent either single-incision (n=150) or multiple-incision thoracoscopic resection (n=382) during the period January 2000 to December 2014. Patients were matched on propensity score at a 1:2 ratio to estimate the effect of treatment on long-term and disease-free survival. Overall survival and disease-free survival were assessed using the Kaplan-Meier method, the log-rank test and Cox proportional-hazards regression.

Results: Propensity matching resulted in 138 patients in the single-incision group and 276 patients in the multiple-incision group. The matched patients in the single-incision group had a significantly better 5-year overall survival than those in the multiple-incision group (P=0.027). Disease-free survival was similar between the two groups before and after matching. The number of chest wall incisions did not influence overall survival or disease-free survival.

Conclusions: The long-term outcomes of single-incision thoracoscopic surgery are comparable to those of multiple-incision thoracoscopic surgery for lung cancer.

Keywords: Survival; single-incision; multiple-incision; thoracoscopic surgery; lung cancer
Mid-term survival outcome of single-port video-assisted thoracoscopic anatomical lung resection: a two-centre experience

Ching Feng Wu, Ricardo Fernandez, de la Torre Mercedes, Maria Delgado, Eva Fieira, Ching Yang Wu, Ming Ju Hsieh, Marina Paradela, Yun-Hen Liu, Diego Gonzalez-Rivas

European Journal of Cardio-Thoracic Surgery, ezy067,
https://doi.org/10.1093/ejcts/ezy067
Published: 03 March 2018  Article history

RECENT ADVANCES IN UNIPORTAL VATS

- Teaching around the world
- The concept of “Advanced instrumentation” and “ultradvanced instrumentation”
- Complex hilum (lymph nodes or fibrosis)
- Complex segmentectomies and lobectomies
- Sleeve broncho-vascular procedures, carinal
- Radical lymph node dissection
- Bleeding control
- Non intubated lobectomy
- Subxiphoid and subcostal resections
- Unisurgeon assisted with robotic arm
- High volume Training courses
THIS IS LIFE:
THE JOURNEY OF UNIPORTAL VATS
Correct Training!!

- Symposia
- Workshops
- Visiting (Observer)
- wetlabs
- Videos
- Training courses (2 weeks)

➢ *Train the Team !!!*
Uniportal LUL and chest wall resection

Bronchial sleeve

Vascular reconstruction

- Direct suture
- Patch
- Sleeve anastomosis
Uniportal bronchial sleeve

Right carinal sleeve pneumonectomy
RUL and carinal resection
High frequency ventilation jet

Non intubated Uniportal VATS lobectomy

Non intubated Uniportal carinal resection

Subxiphoid single incision VATS

Uniportal transcervical Right lower lobectomy
What means advanced instrumentation?
Ultra advanced instrumentation
Advanced instrumentation: Lymph node dissection
Open gate to the future
Uniportal Unisurgeon VATS lobectomy
Uniportal UNISURGEON VATS lobectomy

Uniportal VATS left hand double finger technique
Robotic arm voice control
Wireless Steerable Endoscope
Magnetic graspers
Uniportal robotic platform
Nanotechnology applications in thoracic surgery

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Uniportal VATS in the future

- Improved staplers (electric, more angulated, 5mm)
- Energy devices for vessels and fissure
- Wireless cameras and graspers, remote control
- Robotic instruments (parallel instrumentation)
- Nano technology
- 3D technology (naked eye)
- Non intubated surgery
- Portable drainage systems
- Subxiphoid approach, NOTES?
LESS IS MORE
Shanghai Pulmonary Hospital
Lung resections 2004-2017

2004: 1144
2005: 1440
2006: 1674
2007: 2164
2008: 2413
2009: 2651
2010: 2788
2011: 3350
2012: 4042
2013: 5321
2014: 6855
2015: 8320
2016: 10392

2017: 13,341 major resections
High-volume intensive training course: a new paradigm for video-assisted thoracoscopic surgery education

Alan D.L. Sihoe\textsuperscript{a,b,c,*,} Diego Gonzalez-Rivas\textsuperscript{a,†}, Timothy Y. Yang\textsuperscript{a,†}, Yuming Zhu\textsuperscript{a} and Gening Jiang\textsuperscript{a}

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Abstract

OBJECTIVES: The emergence of ultra-high-volume centres promises new opportunities for thoracic surgical training. The goal of this study was to investigate the effectiveness of a novel observership course in teaching video-assisted thoracoscopic surgery (VATS) at an ultra-high-volume centre.

METHODS: Two-week courses in VATS at a specialist unit now performing >10 000 major lung resections annually (>50 daily on average) were attended by 230 surgeons from around the world from 2013 to 2016. An online survey preserving responder anonymity was completed by 156 attendees (67.8%).

RESULTS: Attendees included 37% from Western Europe, 18% from Eastern Europe and 17% from Latin America. Experience with open thoracic surgery for more than 5 years was reported by 67%, but 79% had less than 5 years of VATS lobectomy experience. During the course, 70% observed over 30 uniporal VATS operations (including 38% observing over 50), and 69% attended an animal wet lab. Although 72% of the responders attended the course less than 12 months ago, the number of ports used (P < 0.001), operation times (P < 0.001) and conversion rates (P < 0.001) reported by the responders were reduced significantly after the course. Improvements in the problem areas of tissue retraction, instrumentation, stapler application and coordination with the assistant during VATS were reported by 56%, 57%, 58% and 53%, respectively. Of those who had attended other VATS courses previously, 87% preferred the training from this high-volume course.

CONCLUSIONS: High-volume intensive observership training at an ultra-high-volume centre may improve VATS proficiency in a short period of time, and may provide a time-efficient modality for future thoracic surgical training.
451 Surgeons from 68 countries & Taiwan/Hongkong

<table>
<thead>
<tr>
<th>Continent</th>
<th>Participants</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>115</td>
<td>25.50%</td>
</tr>
<tr>
<td>Europe</td>
<td>228</td>
<td>50.55%</td>
</tr>
<tr>
<td>America</td>
<td>83</td>
<td>18.40%</td>
</tr>
<tr>
<td>Africa</td>
<td>17</td>
<td>3.78%</td>
</tr>
<tr>
<td>Australia &amp; New Zealand</td>
<td>8</td>
<td>1.77%</td>
</tr>
</tbody>
</table>

**Top 15 Countries**

- **Asia**
  - India: 21
  - Israel: 19
  - KSA: 10
  - Pakistan: 10
  - Philippines: 10
  - Taiwan: 22

- **Europe**
  - Spain: 45
  - UK: 18
  - France: 15
  - Switzerland: 19
  - Italy: 10

- **North America**
  - USA: 10
  - Canada: 10

- **South America**
  - Brazil: 27
  - Chile: 28

- **Surgeons from Asia**
  - Azerbaijan: 1
  - Bangladesh: 3
  - Hong Kong: 4
  - Mainland China: 2
  - HK: 2
  - Indonesia: 10
  - Israel: 10
  - Japan: 9
  - Jordan: 8
  - Korea: 2
  - Kuwait: 1
  - KSA: 1
  - Malaysia: 1
  - Pakistan: 2
  - Philippines: 2
  - Sudan: 1
  - Taiwan: 1
  - Thailand: 1
  - UAE: 1
  - Vietnam: 1
UNIPORTAL VATS TRAINING PROGRAM
SHANGHAI PULMONARY HOSPITAL

Director: Diego Gonzalez Rivas
Coordinator: Timothy Young
More info: vatsprogram@outlook.com
Impossible is nothing. With that as his motto, Spanish surgeon Diego González Rivas takes up his fight against cancer and pain. Using his revolutionary technique, Uniportal VATS, he can remove the most complicated tumors from the lungs through a single incision, sometimes with only local anesthetic, sending his patients home a mere 48 hours after surgery.

Doctor González Rivas (A Coruña, 1974) dislikes calling himself brave, preferring instead to point to his experience. Every year alone, he performs more than 800 major surgeries around the globe, half of them at Shanghai Pulmonary Hospital. In his quest to teach his technique to as many surgeons as possible, he travels the world at such an intense pace, that on many mornings he wakes up not knowing where he is. The first to open a surgery channel on YouTube, he is also one of the most active doctors in disseminating surgical advances on social media.

Journalist and writer Elena Pita passionately unfolds the journey of this surgeon, who dares to undertake the most complex cases for the sake of bringing joy to others.

“You can’t read this book without being affected - it is charged with reality, yet draws us to the unimaginable.” (Enaki Gabaldon, El País)

“Elena Pita elevates the interview to a literary genre in this riveting account of a surgeon and his patients who have regained their lives through his global crusade.” (J. C. Laviana, El Mundo)

Elena Pita (Ares, Spain; September 1962) is a writer and journalist. She is the author of the novels No amaras a tu madre and Amor sin decir Amor, and collection of interviews El bello oficio de hacerse viejo and El oficio de amar, as well as several stories published in literary anthologies. In 1989 she was a member of the founding team of the daily El Mundo, now the second largest printed and first largest digital newspaper in Spain, where she began as one of the editors of the International Policy Desk, then became editor of the Literary Supplement. She ultimately found her niche in the interview format — for which she is now known. Ms. Pita studied Journalism at the Complutense University of Madrid and has done residencies in several European universities.

* 10% of the sales of this book will go to child cancer research promoted by the Fundación María José Jove.
KEEP CALM
And think Uniportal!!