NON INTUBATED UNIPORTAL VATS LOBECTOMY

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Historic review

• 1928- Guedel introduce the endotracheal tube
• 1931- Gale and Waters, tube into bronchus
• 1950- Borj and Carlens- Double lumen tube
• 1956- Vischnevski-phrenic and vagus blockade, intercostal block, novocaine for hilum
• 1960- Ossipov publish more than 3000 patients
• After 1960- introduction of mechanical ventilation
• 2004- Pompeo, awake minor procedures with epidural
• 2007- Al Abdullatif, First non intubated VATS major resection
• 2011- Chen, non intubated lobectomies
• 2014- He J, non intubated segmentectomies
• 2014- Our group, first non intubated uniportal VATS lobectomies
Non intubated VATS lobectomy

Nonintubated thoracoscopic surgery: state of the art and future directions

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Abstract: Video-assisted thoracoscopic lung cancer surgery is a feasible and safe option in selected patients with non-intubated anesthesia. The main advantages of non-intubated thoracoscopic lung cancer surgery are reduced cost and faster recovery. In conclusion, video-assisted thoracoscopic surgery is a valid alternative to thoracotomy.

KEY WORDS: Thoracoscopic; Lung cancer; Surgery; Video-assisted thoracoscopic surgery

Analysis of feasibility and safety of complete video-assisted thoracoscopic resection of anatomic pulmonary segments under non-intubated anesthesia

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Objective: To evaluate the feasibility and safety of complete video-assisted thoracoscopic resection of anatomic pulmonary segments under non-intubated anesthesia.

Methods: Twenty-eight patients underwent video-assisted thoracoscopic resection of anatomic pulmonary segments under non-intubated anesthesia. The outcomes were evaluated in terms of feasibility and safety.

Results: The median operating time was 120 minutes, and the median hospital stay was 3 days. All patients recovered uneventfully, and no complications related to the anesthetic technique were observed.

Conclusions: Video-assisted thoracoscopic resection of anatomic pulmonary segments is feasible and safe under non-intubated anesthesia.

Surgical Technique

Uniportal video-assisted thoracoscopic left upper lobectomy under spontaneous ventilation

Diego Gonzalez-Rivas1, Ricardo Fernandez1, Mercedes de la Torre1, Cesar Bonome1

Objective: To present a case of uniportal video-assisted thoracoscopic left upper lobectomy under spontaneous ventilation.

Methods: The patient underwent a left upper lobectomy using a uniportal VATS approach under spontaneous ventilation. The procedure was performed with a single port and all lung resections were completed via this port.

Results: The operation was completed successfully with no complications. The patient had an uneventful recovery and was discharged on the second postoperative day.

Conclusions: Uniportal VATS lobectomy under spontaneous ventilation is a feasible and safe technique for the treatment of lung lesions.
Negative Effects of Intubated Anesthesia

- **Drugs**: Bronchial intubation requires the use of multiple drugs, including various anesthesia drugs, in addition to muscle relaxants. Use of multiple drugs is more likely to cause an adverse reaction.
- **Postoperative Complications**: Sore throat and dry cough.
- **Other adverse effects**: Bronchial spasm, pulmonary infection, lung injury, arrhythmia, etc.
Intubation
Carinal hook unable to pass by glottis (Carlen's or White DLT)
Unable to advance bronchial limb into bronchus
  - Tube too large
  - Airway obstruction (intrinsic or extrinsic)

Trauma
Dental trauma
Airway injury
  - Laryngitis, mucosal ecchymosis, arytenoid dislocation,
  - tracheobronchial rupture
  - Rupture thoracic aneurysm

Position
Not far enough into bronchus
  - Bronchial cuff in carina
  - Unable to ventilate nonintubated lung with both cuffs inflated or
  - unable to deflate intubated lung
  - Failure to seal airway – contamination of healthy lung
Down wrong bronchus
Too deep in correct bronchus
  - Obstruction of upper lobe causing hypoxemia
  - Failure to collapse upper lobe
Changes during surgery
  - Surgical manipulation
  - Movement of patient to decubitus position
  - Head flexion or extension
  - Tube inadequately taped or secured

Hypoxemia
Malpositioned DLT
  - Collapse upper lobe of nonoperated lung
  - Obstruction by bronchial cuff in trachea
  - Torsion of tube or bronchial lumen opening against bronchial wall
  - Carinal hook bent back obstructing tracheal lumen

Miscellaneous
Bronchial lumen interferes with surgical procedures
  - Pneumonectomy, carinal or sleeve resection, lung transplant
Displacement of mediastinal mass
Bronchial lumen sutured to pulmonary vessel

Figure 1. Schematic diagram shows the distribution of ventilation and the changes that occur in the lateral position in the (A) awake and (B) anesthetized patient. With the induction of anesthesia, the nondependent lung moves from an initial, flat, noncompliant portion of the pressure-volume curve to a steep, more compliant part. The dependent lung moves from the steep, compliant part of the curve to a lower, flat, less compliant part. This results in the majority of the tidal ventilation occurring in the nondependent lung in the anesthetized patient in the lateral position. (From Benumof. With permission.)
Positive Effects of Non-intubated Anesthesia

**Less Trauma:** Avoid injuries and complications caused by endotracheal intubation

**Easy Surgery:** Less restrictions during surgery

**Less Drugs:** No need for muscle relaxants

Faster Recovery: most patients are able to eat and drink after just 2 hours.
Exclusion criteria in VATS major pulmonary resections.

Patients with expected difficult airway management. Mallampati grade III-IV

Hemodynamically unstable patients

Obesity (body mass index >30)

Inexperienced and poorly cooperative surgical team

Coagulopathy (INR > 1.5)

Persistent cough or high airway secretion

Patient with elevated risk of regurgitation.

Neurological disorders: risk of seizure, unable to cooperate, intracranial mass or brain edema.

Extensive pleural adhesions or previous pulmonary resections (related to surgeons’ skills)

Hypoxemia (PaO2 < 60) or hypercarbia (PCO2 > 50)

Central hypoventilation syndrome

Any contraindications for use of regional anesthesia technique specifically selected

Procedures requiring lung isolation to protect the contralateral lung from contamination
Reasons for conversion to general anesthesia

Surgical complications: major bleeding, pleural adhesion, large tumors, lack of surgical thoracoscopic experience

Severe Hypoxemia (PaO2 < 60%), hypercapnia, (PaCO2 > 80) and acidosis (ph < 7.1)

Hemodynamic instability: severe hypotension, cardiac index decreased, intractable arrhythmias, right ventricular failure.

Persistent cough that difficults or prevents performing surgery.

Excessive movement of the diaphragm or mediastinum which cause unsafe surgery.

Failure of regional block where MAC is insufficient and decreases the safety of the procedure.

Inability to collapse the lung: paradoxical maintained ventilation, PEEP intrinsic, dynamic hyperinflation…
Non Intubated Anesthesia

Options in Non Intubated anesthesia

1.) Epidural or paravertebral
2.) Intravenous anesthesia
3.) Intercostal nerve block

+) lidocaine sprayed on the surface of the lung
+) vagus nerve block
+) nebulized lidocaine
Facial mask

Laryngeal mask
Avoid collapse of airway

retract tongue
Non intubated lobectomy is not for everyone!!!

VERY EXPERT VATS SURGEON!!!
VERY EXPERT ANESTHESIOLOGIST!!!
Paravertebral blockade
Spontaneous ventilation
Intercostal blockade
Vagus blockade

Conversion
Non intubated VATS left upper lobectomy

Paratracheal Lymphadenectomy
Complex fissure, 86 years, pulmonary fibrosis NON intubated, Left lower lobectomy

SINGLE PORT VIDEO-ASSISTED THORACOSCOPIC LOBECTOMY UNDER SPONTANEOUS VENTILATION IN A HIGH RISK PATIENT. Gonzalez-Rivas D. CTSNET. November 2014.
Non intubated lingulectomy (adhesions, complex hilum)
Bleeding control
Non Intubated sleeve resection
Wrong indication
Obese patient BMI >30
Non-intubated video-assisted thoracoscopic lung resections: the future of thoracic surgery?

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Abstract

Thanks to the experience gained through the improvement of video-assisted thoracoscopic surgery (VATS) technique, and the enhancement of surgical instruments and high-definition cameras, most pulmonary resections can now be performed by minimally invasive surgery. The future of the thoracic surgery should be associated with a combination of surgical and anaesthetic evolution and improvements to reduce the trauma to the patient. Traditionally, intubated general anaesthesia with one-lung ventilation was considered necessary for thoracoscopic major pulmonary resections. However, thanks to the advances in minimally invasive techniques, the non-intubated thoracoscopic approach has been adapted even for use with major lung resections. An adequate analgesia obtained from regional anaesthesia techniques allows VATS to be performed in sedated patients and the potential adverse effects related to general anaesthesia and selective ventilation can be avoided. The non-intubated procedures try to minimize the adverse effects of tracheal intubation and general anaesthesia, such as intubation-related airway trauma, ventilation-induced lung injury, residual neuromuscular blockade, and postoperative nausea and vomiting. Anaesthesiologists should be acquainted with the procedure to be performed. Furthermore, patients may also benefit from the efficient contraction of the dependent hemidiaphragm and preserved hypoxic pulmonary vasoconstriction during surgically induced pneumothorax in spontaneous ventilation. However, the surgical team must be aware of the potential problems and have the judgement to convert regional anaesthesia to intubated general anaesthesia in enforced circumstances. The non-intubated anaesthesia combined with the uniportal approach represents another step forward in the minimally invasive strategies of treatment, and can be reliably offered in the near future to an increasing number of patients. Therefore, educating and training programmes in VATS with non-intubated patients may be needed. Surgical techniques and various regional anaesthesia techniques as well as indications, contraindications, criteria to conversion of sedation to general anaesthesia in non-intubated patients are reviewed and discussed.

Keywords: Non-intubated patient • Awake surgery • Lobectomy • Spontaneous ventilation • Local anaesthesia • Uniportal
• Midazolam 0.1 mg/kg
• Nasal canulae, Facial mask, laryngeal mask, nasopharyngeal tube
• Propofol iv (10 mg/mL) or Gas (Oxygen at 50% with a minimum alveolar concentration of 1.5-2%)
• Remifentanyl iv (0.04 mcg/kg/min)
• Dexmetomidine
• Intercostal block, paravertebral blockade, Epidural
• Vagus blockade (2 mL of 0.25% bupivacaine adjacent to the vagus nerve at the level of the lower trachea for right-sided operations and at the level of the aortopulmonary window for left-sided operations)
• Topic anesthesia (hilium, lung surface)
• Nebulization of Lidocaine
“NOW THIS IS NOT THE END. IT IS NOT EVEN THE BEGINNING OF THE END. BUT IT IS, PERHAPS, THE END OF THE BEGINNING.”

Winston Churchill

© Lifehack Quotes

Winston Churchill, 1942
First non intubated VATS course
Guanzhou, 7-11 December 2015
Subxiphoid Uniportal VATS resections

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Tongji University, Shanghai, China
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
Learning subxiphoid?
Uniportal VATS

PA Resection & Reconstruction

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

Unisurgeon 2016
Carinal resection 2015
Subxiphoid resections
Non intubated surgery 2014
Double sleeve 2014

Single-port thoracoscopic lobectomy in a nonintubated patient: the least invasive procedure for major lung resection?
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Accepted: 17 July 2015

Uniporal video-assisted thoracoscopic bronchial sleeve lobectomy: First report
Diego Gonzalez-Rivas, MD, FECTS, Ricardo Fernandez, MD, Eva Fieira, MD, and LuzDivina Rellán, MD, Coruna, Spain

Single-incision video-assisted thoracoscopic right pneumonectomy
Diego Gonzalez-Rivas - Mercedes de la Torre - Ricardo Fernandez - Jose Garcia
Does Single-incision Thoracoscopic Lobectomy for Lung Cancer Reduce Postoperative Pain?

Subxipoid single-incision thoracoscopic left upper lobectomy

Chia-Chuan Liu, MD, Ping-Yen Wang, MD, Chih-Shiun Shih, MD, and Yun-Hen Liu, MD, Taipei, Taichung, and Keelung, Taiwan

Thoracoscopic surgery has been shown to be a feasible and safe technique for performing lobectomy. Thoracoscopic lobectomy is normally performed through 2 or 4 incisions, although cases of single-incision thoracoscopic lobectomy have been reported. We present a novel technique for performing thoracoscopic lobectomy through a single subxipoid incision.

CLINICAL SUMMARY

A 49-year-old woman came to our clinic with a pulmonary nodule that was incidentally found on plain film radiographs of the chest. Computed tomography of the chest demonstrated an irregular soft-tissue lesion, measuring 3 × 3 cm, in the left upper lobe without mediastinal lymph node enlargement. Positron emission tomography and computed tomography revealed intense focal fludeoxyglucose (F18) (18F-fludeoxyglucose [18F]) uptake in the lesion without distant metastases. Computed tomographically guided biopsy of the mass lesion was performed, and the results of histopathologic analysis of the biopsy specimen were positive for adenocarcinoma, clinical stage T1NO0.

After written, informed consent was obtained from the patient, a thoracoscopic lobectomy was performed through a small subxipoid incision. Radical mediastinal lymph node sampling was also carried out. The intensity of postoperative pain was evaluated every 8 hours by means of a visual analog scale, which ranged from 0 (painless) to 10 (worst pain ever experienced). The mean pain scores at rest were 3, 2, and 0 immediately after the operation, the day after the operation, and 2 days after the procedure, respectively. Pain was limited to the subxipoid area. The patient's postoperative course was uneventful, and she was discharged on the third day after surgery.

The resected tumor measured 3.5 cm, and the pathologic stage was T2aN0M0. A total of 11 lymph nodes (2 at station 4L, 3 at station 5, 2 at station 10, 1 at station 11, and 5 at station 12/13/14) were dissected, and 2 segmental lymph nodes had positive results for malignancy.

TECHNIQUE

After induction of general anesthesia and intubation with a double-lumen endotracheal tube, the patient was put in the right semievert position at a 45° angle to the table. A 4-cm transverse incision was made over the subxipoid area, a subcostal tunnel was created, and a wound protector was placed into the wound to provide optimal exposure. The sternocostal margin was lifted with a retractor (Figure 1.

![Figure 1](https://example.com/figure1.jpg)

**FIGURE 1.** A. Photograph of the lifting of the sternocostal margin with a retractor. B. Photograph of the 10-mm, 30° angled thoracoscope, the endostapler, and other working instruments used during surgery.
**Incisions**

A 4-cm-long horizontal subxiphoid incision, if infrasternal angle $\geq 70^\circ$

A longitudinal incision if infrasternal angle $< 70^\circ$. 
Subxiphoid single incision VATS
Subxiphoid single incision VATS

Subcostal incision Uniportal
Subcostal incision Uniportal VATS

Bimanual instrumentation
Assistant on the other side
Resection of subxiphoid process
RUL big tumor with tracheal bronchus
Subcostal Uniportal left lower lobectomy
Uniportal subxiphoid trisegmentectomy
Subxiphoid apical segment S1
Subxiphoid uniportal Segmentectomy (S8)
Subxiphoid uniportal lymph node dissection

Strong adhesions
Subxiphoid RUL and thymectomy

Argueta AJ, Cañas SR, Abu Akar F, González-Rivas D. Subxiphoid approach for a combined right upper lobectomy and thymectomy through a single incision. J Vis Surg 2017. doi: 10.21037/jovs.2017.06.06
Subcostal resection big mediastinal mass (11.6x7.9x6.5 cm)
Subxiphoid bleeding control
Subxiphoid training
Initial experience in uniportal subxiphoid video-assisted thoracoscopic surgery for major lung resections

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** Minimally Invasive Thoracic Surgery Unit (UCTM), Comuna Hospital, Comuna, Spain

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Abstract

OBJECTIVES: Uniportal subxiphoid video-assisted thoracoscopic (SVATS) surgery for major lung resections is a new approach, but clinical evidence is lacking. The aim of this study was to examine our experience with the use of the uniportal subxiphoid approach in video-assisted thoracoscopic (VATS) major lung resections and lymph node dissections.

METHODS: From October 2014 to August 2015, 153 patients with early-stage non-small-cell lung carcinoma (NSCLC) and benign disease underwent uniportal subxiphoid VATS major lung resections. Patients were placed in a lateral position with 60–70° inclination, and a 4- to 5-cm midline median or transverse incision was made below the sternocostal triangle. A 10-mm 30° video camera and VATS instruments were used through the same single incision. Perioperative variables and outcomes were collected prospectively and analysed retrospectively.

RESULTS: Of the 153 patients who underwent surgery with the uniportal subxiphoid VATS approach, 105 had lobectomies and 48 had segmental resections; 135 cases of lung cancer and 18 cases of benign pulmonary disease were noted. Right upper lobectomy was the most common procedure (51%), and left upper lobectomy was the most time-consuming procedure (190 ± 21 min). The mean operating time was 166.9 ± 12.6 min; the average volume of blood loss was 127.5 ± 27.6 ml. In patients with lung cancer, the mean total number of lymph node stations explored was 3.4 ± 0.8. The duration of chest drain use was 2.6 ± 0.2 days. The length of hospital stay was 4.3 ± 0.4 days. Perioperative arrhythmia was the most common complication (13% of cases). Prolonged air leak was the cause of prolonged hospital stay. Five cases were converted to conventional VATS due to technical difficulties, and eight cases were converted to thoracotomy due to major bleeding. Postoperative 30-day mortality was zero and there were no re-admissions. All cases had a R0 complete cancer resection on histology.

CONCLUSIONS: Uniportal subxiphoid VATS lobectomy/segmentectomy is a feasible and safe procedure for early-stage lung cancer and benign disease.

Keywords: VATS • Subxiphoid • Uniportal
Advantages

- To avoid chronic postoperative incisional pain
- Suitable for bilateral procedures
- Suitable for anterior mediastinal tumor resection
- No requirement for changes in the body position
- Cost saving, good cosmetic appearance
Relative contraindications

- Diffuse dense adhension
- Lung cancer with lymph nodes enlargement
- Body Mass Index, BMI > 30
- Cardiomegaly patients with left-side diseases
- Reoperation
## Operative variables

<table>
<thead>
<tr>
<th></th>
<th>Right side (n=110)</th>
<th>Left side (n=47)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time (min)*</td>
<td>156 ± 0.8</td>
<td>156 ± 0.8</td>
<td>0.97</td>
</tr>
<tr>
<td>Intraoperative blood loss (mL)*</td>
<td>107.0 ± 73.2</td>
<td>100.0 ± 54.3</td>
<td>0.56</td>
</tr>
<tr>
<td>Lymph node stations sampled</td>
<td>4.3 ± 0.7</td>
<td>4.3 ± 1.1</td>
<td>0.91</td>
</tr>
<tr>
<td>Lymph node number</td>
<td>12.7 ± 2.2</td>
<td>13.1 ± 2.6</td>
<td>0.54</td>
</tr>
<tr>
<td>Chest drainage volume (L)</td>
<td>254.1 ± 138.0</td>
<td>283.1 ± 154.8</td>
<td>0.25</td>
</tr>
<tr>
<td>Postoperative hospital stay (d)*</td>
<td>4.4 ± 1.8</td>
<td>4.6 ± 1.6</td>
<td>0.61</td>
</tr>
<tr>
<td>Chest tube drainage duration (d)</td>
<td>5.0 ± 1.7</td>
<td>5.0 ± 2.5</td>
<td>0.99</td>
</tr>
</tbody>
</table>

* 4 Patients underwent bilateral procedures were excluded from statistical analysis.

### Operative complications

<table>
<thead>
<tr>
<th></th>
<th>Right side (n=110)</th>
<th>Left side (n=47)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intraoperative events (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>arrhythmia</td>
<td>7 (6.3)</td>
<td>28 (59.6)</td>
<td>0.00</td>
</tr>
<tr>
<td>hypotension</td>
<td>4 (3.6)</td>
<td>36 (76.6)</td>
<td>0.00</td>
</tr>
<tr>
<td>surgery interruption</td>
<td>5 (4.5)</td>
<td>28 (59.6)</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Postoperative complications (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hemothorax</td>
<td>0 (0)</td>
<td>1 (2.1)</td>
<td>0.29</td>
</tr>
<tr>
<td>prolonged air leak</td>
<td>5 (4.5)</td>
<td>3 (6.3)</td>
<td>0.63</td>
</tr>
<tr>
<td>arrhythmia</td>
<td>7 (6.4)</td>
<td>2 (4.2)</td>
<td>0.72</td>
</tr>
<tr>
<td>mortality</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td></td>
</tr>
</tbody>
</table>
## Visual Analogue pain score

<table>
<thead>
<tr>
<th></th>
<th>No pain(%)</th>
<th>Mild pain(%)</th>
<th>Moderate pain(%)</th>
<th>Severe pain(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>score 0</td>
<td>score 1-3</td>
<td>score 4-6</td>
<td>score 7-10</td>
</tr>
<tr>
<td>POD1</td>
<td>3 (2.0)</td>
<td>6 (3.9)</td>
<td>50 (32.7)</td>
<td>94 (61.4)</td>
</tr>
<tr>
<td>POD3</td>
<td>12 (7.8)</td>
<td>18 (11.8)</td>
<td>65 (42.5)</td>
<td>58 (37.9)</td>
</tr>
<tr>
<td>POD7</td>
<td>104 (68.0)</td>
<td>28 (18.3)</td>
<td>20 (13.1)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>POD14</td>
<td>144 (94.1)</td>
<td>7 (4.6)</td>
<td>2 (1.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>POD28</td>
<td>152 (99.3)</td>
<td>1 (0.7)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>POD 3 mon</td>
<td>153 (100)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

![Bar chart showing pain scores over time](chart.png)

- **yellow**: mild pain
- **blue**: moderate pain
- **red**: no pain
- **gray**: severe pain
“Life begins at the end of your comfort zone...”