Video Assisted Thoracoscopic Surgery (VATS) and One Lung Anesthesia Management

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Disclosure

• Advisory board member of the ET View Medical, Ltd.
• Paid consultant ET View Medical, Ltd.

General Facts

• Each year in the US, 173,000 Americans are diagnosed with lung cancer
• 78,000 lobectomies and pneumonectomies are performed each year in the U.S.
• Approximately 5% are performed with video-assisted thoracoscopic surgery (VATS)
• Morbidity VATS (2-22%)
• Mortality VATS (0.5-2.0%)

Objectives

• Advantages
• Robotic assisted VATS
• Lung separation
• Ventilatory strategies
• Paravertebral blocks
• Outcomes
• Recommendations

Advantages of VATS

• Less pulmonary complications in pts with FEV₁ <60%
• Preserved postoperative pulmonary function
• Decreased blood loss
• Decreased pain
• Decreased inflammatory response
• Shorter length of stay

Thoracoscopic Lobectomy is Associated with Lower Morbidity Compared with Thoracotomy

<table>
<thead>
<tr>
<th>Complication</th>
<th>THOR (n=582)</th>
<th>VATS (n=697)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation (%)</td>
<td>85 (22)</td>
<td>111 (16) SS</td>
</tr>
<tr>
<td>Transfusion n (%)</td>
<td>46 (12)</td>
<td>34 (5) SS</td>
</tr>
<tr>
<td>Atelectasis n (%)</td>
<td>47 (12)</td>
<td>25 (4) SS</td>
</tr>
<tr>
<td>Pneumonia n (%)</td>
<td>55 (9)</td>
<td>29 (4) SS</td>
</tr>
<tr>
<td>Prolonged air leak n (%)</td>
<td>73 (19)</td>
<td>77 (11) SS</td>
</tr>
<tr>
<td>Length of hospital stay</td>
<td>5 (4-7)</td>
<td>4 (3-5) SS</td>
</tr>
<tr>
<td>Deaths</td>
<td>22 (6)</td>
<td>14 (2) SS</td>
</tr>
</tbody>
</table>


VATS and Morbidity and Mortality

<table>
<thead>
<tr>
<th>Author</th>
<th>n End Points</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKenna RJ, et al: Ann Thorac Surg 2006; 81:421-6</td>
<td>n=1100 cases Retrospective observation study</td>
<td>Morbidity and mortality Safety Mortality 15% Mortality 0.8%</td>
</tr>
<tr>
<td>Onaitis MW, et al: Ann Surg 2006; 244: 420-5</td>
<td>n=500 cases Prospective consecutive patients</td>
<td>Morbidity and mortality Safety efficacy Mortbility 20% Mortality 1.2%</td>
</tr>
</tbody>
</table>

Campos JH: Curr Opin Anaesthesiol 2010; 23:1–6

VATS: Robotic Surgery

<table>
<thead>
<tr>
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Campos, Javier, MD Video Assisted Thoracoscopic Surgery (VATS)
Limitations with Robotic Surgery

- Lengthy operations (surgical times > 8 hrs)
- Conversion to an open procedure
- Failure of the equipment
- Cost/effectiveness
- Minimal net revenue

Campos JH: Anaesthesia International 2011; 19-22

Points to Consider While Robotic Surgical System is in Use

- No changes in patients position on OR table once the robot has been docked
  Campos JH: Curr Opin Anaesthesiol 2010; 23:1-6
- Protection of pressure points (arms and legs)
- Avoidance of stretching the arms
- Attention to crushing injuries by robotic arms
  Campos JH: Minerva Anestesiol 2013; 79:1-6

Surgical Access for VATS or Robotic Surgery

VATS with a Single-Lumen Tube

- n= 376 pts. VATS
- n=208 pts. underwent biopsy of parietal pleura and talc pleurodesis
- All received single-lumen endotracheal tube
- Apneic period (prior opening chest)
- Tidal volume 150-250 ml


Lung Separation

- Double Lumen Tube
  - L-DLT
  - R-DLT
- Bronchial Blocker
  - Arndt, Cohen, Fuji, EZ Blocker
- Video thoracoscopic surgery (VATS)
- Difficult airways (oral or nasal intubation)
- Unique situations (tracheostomy pts)
- Selective lobar blockade


Campos JH: Cadaver Study with MDCT

Right-Sided Spherical Shaped Bronchial Blocker

Campos JH: Curr Opin Anaesthesiol 2009; 22: 4-10

The Use of Air in the Inspired Gas Mixture During Two-Lung Ventilation Delays Lung Collapse During One-Lung Ventilation


Performance Bronchial Blockers vs Double-Lumen Tubes


- Administer FiO₂ 1.0%
- Prior to balloon inflation stop ventilation
- Under direct FOB insufflate balloon
- Start intermittent suction
- Reassume ventilation dependent lung
A Comparison of the EZ-Blocker with a Cohen Flex-Tip Blocker for OLV

<table>
<thead>
<tr>
<th>PRCT</th>
<th>Cohen Group n=20 Right/Left</th>
<th>EZ Group n=20 Right/Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Blocker balloon herniation into trachea</td>
<td>1/1</td>
<td>0</td>
</tr>
<tr>
<td>• Blocker balloon not visible below carina</td>
<td>3/0</td>
<td>0</td>
</tr>
<tr>
<td>• Both balloons of EZ-blocker going into same main bronchus</td>
<td>NA</td>
<td>2/1</td>
</tr>
<tr>
<td>Surgeon Satisfaction (Lung Collapse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Good</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>• Fair</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>


Predictors of Hypoxia During OLV

<table>
<thead>
<tr>
<th>Author</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Slinger P, et al</td>
<td>50 (retrospective) 30 (prospective)</td>
<td>• Potential predictors of PaO2 during OLV</td>
<td>• Side right of operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Preoperative FEV1/FVC</td>
<td>• Interoperative PaO2, 20 min</td>
</tr>
<tr>
<td>Suemitsu R, et al</td>
<td>822 (retrospective)</td>
<td>• Effect BMI and complications in thoracic surgery</td>
<td>• BMI &gt;30 kg/m²</td>
</tr>
</tbody>
</table>

Alveolar Recruitment Strategies

<table>
<thead>
<tr>
<th>Author</th>
<th>n</th>
<th>End Points</th>
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</thead>
<tbody>
<tr>
<td>Unzueta C, et al</td>
<td>40</td>
<td>PCT</td>
<td>• Effects on oxygenation</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>n=20 control (6 ml kg V̇)</td>
<td>• Alveolar Recruitment</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>n=20 ARS study group</td>
<td>• PIP 40cmH2O PEEP 5-20 cmH2O for 10 breaths before and after OLV (1 min)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• PaO2 during OLV 20 min</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Control group 182±79</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• ARS study group 251±69 (mmHg)</td>
</tr>
</tbody>
</table>

This may cause transient hypotension
Also a transient further decrease in PaO2
Improvement on oxygenation and decrease alveolar dead space

Fiberoptic Bronchoscopy Segmental O2 Insufflation


Campos, Javier, MD

Video Assisted Thoracoscopic Surgery (VATS)

CRASH 2014

• CPAP must be applied to fully inflated recruited lung to be effective (5-10 Cm H2O)
**VATS Lobectomy Reduces Cytokine Responses Compared with Conventional Surgery**

- \( n = 36 \) pts (clinical stage I non-small cell cancer)
- Group 1, \( n = 18 \) VATS lobectomy
- Group 2, \( n = 18 \) open thoracotomy
- Plasma levels - tumor necrosis factor-\( \alpha \) (TNF-\( \alpha \))
  - Interleukin (IL) 1\( \beta \), IL-6, IL-8
  - anti-inflammatory cytokine IL-10


<table>
<thead>
<tr>
<th></th>
<th></th>
<th>IL-8 pg/mL</th>
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<tbody>
<tr>
<td></td>
<td>BS</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>End</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4h</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>8h</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>24h</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>48h</td>
<td>0</td>
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**VATS with Local Anesthesia-Sedation**

- \( n = 115 \) VATS, ages (21-88)
- Sedation (midazolam, fentanyl, propofol)
- Propofol infusion 120ug/kg/min
- \( \text{O}_2 \) face mask, ETCO\(_2\) monitor
- Local infiltration (lidocaine)


**Points to Consider During an Awake VATS**

- Intraoperative pneumothorax
- Patient coughing or moving (upon touching cartilaginous bronchioles)
- Potential for conversion: general anesthesia/open thoracotomy


**Feasibility and Results of Awake Thoracoscopic Resection of Solitary Pulmonary Nodules**

- \( n = 60 \) pts randomized into two groups
  - Group 1 \( n = 30 \) VATS-OLV-general anesthesia
  - Group 2 \( n = 30 \) VATS-Thoracic epidural anesthesia (T\(_4\))
- Surgical technique – lateral decubitus position
  - 3-flexible-thoracoscopic-trocar access
- VATS was easily and safely performed TEA 26/28 pts.


**VATS at 20 years: a Consensus Statement**

- Summary of responses regarding perioperative management of VATS lobectomy (international panel 50 experts)
- Preferred postoperative pain management

<table>
<thead>
<tr>
<th>Technique</th>
<th>( n = ) Respondents (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCA (only)</td>
<td>6 (12)</td>
</tr>
<tr>
<td>Epidural</td>
<td>17 (34)</td>
</tr>
<tr>
<td>Paravertebral</td>
<td>10 (34)</td>
</tr>
<tr>
<td>Intercostal nerve block</td>
<td>17 (34)</td>
</tr>
</tbody>
</table>

Thoracic Paravertebral Block for VATS

<table>
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<th>Author</th>
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<tbody>
<tr>
<td>Nishida et al</td>
<td>10</td>
<td>Single injection PVB vs multiple injection PVB</td>
<td>Pain scores lower in single injection group up to 48 hours</td>
</tr>
<tr>
<td>Hill et al</td>
<td>30</td>
<td>Single injection PVB vs multiple injection PVB</td>
<td>Pain scores lower in single injection group up to 48 hours</td>
</tr>
</tbody>
</table>

Summary

- Thoracoscopic surgery has many advantages over open thoracotomies
- Mortality (-), however morbidity (+)
- Anesthesia techniques that best suit your practice
- DLT for the vast majority of cases or BB
- Paravertebral blocks for analgesia
- Robotic assisted surgery needs further research

Reference List


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