Video Assisted Thoracoscopic Surgery versus Thoracotomy for lung cancer resection

Jess Schultz
5/15/06
Overview

- **Background**
  - Epidemiology
  - Significance
  - Risk factors

- **Goals of surgical therapy for lung cancer**

- **Comparison of thoracotomy vs. minimally invasive lung resections**
Lung Cancer: Background

• Lifetime risk of developing lung cancer\(^1\)
  – Male: 1 in 13
  – Female: 1 in 17

• During 2006, there will be about 174,470 new cases of lung cancer (NSCCa and SCCa)\(^1\)
  – Lung cancer will account for about 13\% of all new cancers

• Overall cost of treating lung cancer exceeds $9.6 billion in the US each year\(^2\)

---

1. ACS: www.cancer.org
2. Medical Care v40 IV104-117, 2002
Lung Cancer: risk factors

- **Smoking** (responsible for > 87% of cases)
- **Age** (>70% of people with lung ca are > 65yo)
- **Asbestosis** (50 – 90x)
- **Radon**
- **Radiation therapy to the chest**
- **Workplace carcinogen exposure**
  (arsenic, uranium, gasoline)
- **Family history** (susceptibility may arise on ch 6)
Lung Cancer: incidence

U.S. Lung and Bronchus Cancer Incidence

Incidence per 100,000


White Males
White Females
Overall Rate
African American Males
African American Females

NCI: www.cancer.gov
Lung Cancer: risk factors

(Rates / 100,000 persons)
Lung Cancer: Background

- Lung cancer is the most common cause of cancer morbidity in the United States with an estimated 162,460 deaths in 2006
  - 90,330 among men
  - 72,130 among women

- More people die of lung cancer than of colon, breast, and prostate cancers combined.

ACS:  [www.cancer.org](http://www.cancer.org)
Lung Cancer: Significance

- Diseases of heart: 340,933
- Lung and bronchus cancer: 90,121
- Accidents (unintentional injury): 69,257
- Cerebrovascular disease: 62,622
- Chronic lower respiratory disease: 60,713
- Diabetes mellitus: 34,301
- Prostate cancer: 30,466
- Influenza and pneumonia: 28,918
- Colorectal cancer: 28,471
- Intentional self-harm (suicide): 25,409

www.cdc.gov
Lung Cancer Mortality
# Lung Cancer staging

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tis</td>
<td>no evidence of primary</td>
<td>N0</td>
</tr>
<tr>
<td>T0</td>
<td>&lt; 3 cm, surrounded by parenchyma</td>
<td>N1: ipsilateral hilar LN</td>
</tr>
<tr>
<td>T1</td>
<td>&gt; 3 cm in size, or within 2 cm of the carina or invading visceral pleura</td>
<td>N2: ipsilateral mediastinal or subcarinal</td>
</tr>
<tr>
<td>T2</td>
<td>invades the chest wall or pericardium, parietal pleura</td>
<td>N3 contralateral LAD</td>
</tr>
<tr>
<td>T3</td>
<td>invasion of thoracic structures, or ipsilateral tumor</td>
<td>0 TisNoMo</td>
</tr>
<tr>
<td>T4</td>
<td>invasion of thoracic structures, or ipsilateral tumor</td>
<td>1A T1NoMo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1B T2NoMo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2A T1N1Mo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2B T2N1Mo or T3NoMo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3A T3N1Mo or T1-3N2Mo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3B T4N0-2 Mo or T1-4N3,M0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 M1</td>
</tr>
</tbody>
</table>
Stage distribution of lung cancer at the time of diagnosis

Goals of surgical therapy for lung cancer

• Complete removal of tumor, and all associated lymphatic drainage

• Minimize risk of tumor spillage

• En bloc resection of invaded structures is preferable to discontinuous resection

Wigle et al, Sabiston Surgery of the Chest 7 ed, p 252
“Open” approaches to lung resections
Posterolateral thoracotomy

- Limited vs. standard
- Muscle Sparing vs. Non-muscle sparing
“Open” approaches to lung resections other incisions

• Anterior limited thoracotomy
• Antero-axillary thoracotomy
• Median sternotomy
Indications for surgical therapy in lung cancer

• Tumor is operable:
  stage 1-3a
  occasion 3b disease (T4NoMo)

• Intra-pulmonary metastases are ipsilateral

• Patient can tolerate both surgery as well as removal of pulmonary parenchyma

Wigle et al, Sabiston Surgery of the Chest 7 ed, p 252
Contra-indications to use of VATS for

**Absolute**

- Inability to achieve complete resection
  - T3 or T4 tumors
  - N2 or N3 disease
- Inability to obtain single lung ventilation

**Relative**

- Presence of hilar lymphadenopathy complicating dissection
- Prior thoracic radiation
- Tumors visible at bronchoscopy

Controversies surrounding VATS lung resections for lung cancer

• Variable definitions
  – Port size
  – Individual hilar dissection vs. simultaneous stapling
  – Lymph node dissection vs. sampling

• No standard Randomized trials comparing VATS resection with open resection

• Outcomes measures

• Oncologic concerns
Is VATS Lobectomy a unified approach?
Yim et al, ATS; 66: 1155-8, 1998

• Questionnaire mailed to 45 thoracic surgeons (world-wide) believed to perform VATS lobectomy because of either publications or knowledge by authors

• 42 surgeons responded, and of these, only 33 still performed VATS Lobectomies

• 12 surgeons reported using VATS for > 30% of their lobectomies

• Rate of conversion for 24 respondents was < 10%
VATS Lobectomy a unified approach?
Yim et al, ATS; 66: 1155-8, 1998

- Use of a rib spreader greater than occasionally 18 / 33

- Average length of skin incision
  - 4-6 cm n=17
  - 6-8 cm n = 15
  - 8-10 cm n=1

- 22 respondents used an anterolateral working incision
VATS Lobectomy a unified approach?
Yim et al, ATS; 66: 1155-8, 1998

• Method of visualization
  – Primarily endoscopic 54%
  – Utility thoracotomy 10%
  – Combination 36%

• Hilar control
  – Individual ligation 85%
  – Simultaneous stapling 15%

• Mediastinal lymph nodes
  – Never sampled 9%
  – Selectively sample 52%
  – Always sample or perform dissection 39%
VATS Lobectomy: definitions

- Anatomic lobectomy using
  - individual hilar dissection
  - node sampling or dissection

- Incisions: 2-4 without rib spreading

- Lobes are removed in a bag through one port enlarged up to 8 cm.
Video-assisted thoracic surgery
lobectomy: experience with 1100 cases
McKenna RJ et al, ATS 81: 421-6, 2006

• Retrospective review of 1100 VATS lobectomies performed from 1992-2004
  – Mean follow-up was not reported

• Diagnoses:
  – Primary lung cancer 1015
  – Benign lung disease 53
  – Pulmonary metastases or lymphoma 32

• Conversion to thoracotomy 28
  – Optimal resection 7
  – Bleeding 6
  – Tumor size 3
  – Other 14
Video-assisted thoracic surgery lobectomy: experience with 1100 cases
McKenna RJ et al, ATS 81: 421-6, 2006

<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical</th>
<th>Pathologic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>59.4%</td>
<td>51%</td>
</tr>
<tr>
<td>1B</td>
<td>28.5%</td>
<td>22.5%</td>
</tr>
<tr>
<td>2A</td>
<td>1.3%</td>
<td>4.5%</td>
</tr>
<tr>
<td>2B</td>
<td>0.9%</td>
<td>2.5%</td>
</tr>
<tr>
<td>3A</td>
<td>2.2%</td>
<td>9.9%</td>
</tr>
<tr>
<td>3B</td>
<td>0</td>
<td>1.5%</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0.2%</td>
</tr>
</tbody>
</table>
Video-assisted thoracic surgery lobectomy: experience with 1100 cases
McKenna RJ et al, ATS 81: 421-6, 2006

• No intra-operative deaths
• Peri-operative deaths (n=9)
  Respiratory failure (3), PE (3), MI (2) mesenteric infarction (1)
• Complications 15.3%
  – Air leak 56
  – Afib 32
  – Serous drainage 14
  – Readmission 13
  – MI 10
  – Empyema 4
  – BPF 3
• Blood transfusions required in 4.1%
Thirty-day operative mortality for thoracotomy in lung cancer

Wada et al, JTCVS 115:70, 1998

- Retrospective review of 7099 patients undergoing thoracotomy for resection of lung cancers between January and December 1994
- The overall 30-day operative mortality was 1.3%.
  - pneumonectomy : 3.2%
  - Lobectomy : 1.2%
What happens to patients undergoing lung cancer surgery?
5 year survival rates after “open” vs. VATS lobectomy

<table>
<thead>
<tr>
<th>STAGE</th>
<th>Mountain 5y survival</th>
<th>Mountain N</th>
<th>Rami-porta 5y survival</th>
<th>Rami-porta N</th>
<th>McKenna 5y survival</th>
<th>McKenna N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>67 %</td>
<td>511</td>
<td>58 %</td>
<td>235</td>
<td>76 %</td>
<td>497</td>
</tr>
<tr>
<td>1B</td>
<td>57 %</td>
<td>549</td>
<td>50 %</td>
<td>817</td>
<td>75 %</td>
<td>245</td>
</tr>
<tr>
<td>2A</td>
<td>55 %</td>
<td>76</td>
<td>66 %</td>
<td>31</td>
<td>56 %</td>
<td>245</td>
</tr>
<tr>
<td>2B</td>
<td>38 %</td>
<td>375</td>
<td>42 %</td>
<td>290</td>
<td>72 %</td>
<td>59</td>
</tr>
<tr>
<td>3A</td>
<td>26 %</td>
<td>399</td>
<td>25 %</td>
<td>389</td>
<td>33 %</td>
<td>108</td>
</tr>
<tr>
<td>3B</td>
<td>4 %</td>
<td>1030</td>
<td>28%</td>
<td>138</td>
<td>70%</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>1%</td>
<td>1427</td>
<td>28%</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

McKenna et al ATS: 81: 421, 2006
Video-assisted thoracic surgery lobectomy: experience with 1100 cases
McKenna RJ et al, ATS 81: 421-6, 2006
Long-term benefits for the quality of life after VATS lobectomy in patients with lung cancer
Sugiura et al, Surg Lap Endoscopy 9: 403, 1999

• Retrospective case series of 25 consecutive patients with clinical stage 1 NSCCa
  – Conversion to open occurred in 3 patients

• Compared with 22 patients who had previously underwent thoracotomy for clinical stage 1 NSCCa

• Acute pain assessed by narcotic requirements or need for epidural analgesia

• Long term quality of life assessed with a questionnaire sent to those patients who “were well and without recurrence”
Long-term benefits for the quality of life after VATS lobectomy in patients with lung cancer
Sugiura et al, Surg Lap Endoscopy 9: 403, 1999

<table>
<thead>
<tr>
<th></th>
<th>VATS</th>
<th>Thoracotomy</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time</td>
<td>227 ±47</td>
<td>196 ±64</td>
<td>NS</td>
</tr>
<tr>
<td>Blood loss</td>
<td>150 ±26</td>
<td>300±192</td>
<td>0.009</td>
</tr>
<tr>
<td>Post-op complications</td>
<td>N=6</td>
<td>N=7</td>
<td></td>
</tr>
<tr>
<td>LOS (days)</td>
<td>23 ±18</td>
<td>22 ±15</td>
<td>NS</td>
</tr>
<tr>
<td>Epidural duration</td>
<td>3 ±2</td>
<td>7 ±4</td>
<td>0.001</td>
</tr>
<tr>
<td>Analgesia use</td>
<td>14 ±5</td>
<td>18 ±5</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Long-term benefits for the quality of life after VATS lobectomy in patients with lung cancer
Sugiura et al, Surg Lap Endoscopy 9: 403, 1999

<table>
<thead>
<tr>
<th></th>
<th>VATS</th>
<th>Thoracotomy</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to pre-op activity (months)</td>
<td>2.5 ±1.7</td>
<td>7.8 ±8.6</td>
<td>0.03</td>
</tr>
<tr>
<td>Requirement for narcotics</td>
<td>N=0</td>
<td>N=4</td>
<td>0.01</td>
</tr>
<tr>
<td>Satisfaction with pain (score)</td>
<td>1.6 ±0.7</td>
<td>1.8 ±0.6</td>
<td>NS</td>
</tr>
<tr>
<td>Satisfaction with shoulder function</td>
<td>1.3 ±0.6</td>
<td>1.5 ±0.7</td>
<td>NS</td>
</tr>
<tr>
<td>Satisfaction with scar</td>
<td>1.5 ±0.5</td>
<td>2.1 ±0.5</td>
<td>0.001</td>
</tr>
<tr>
<td>Overall satisfaction</td>
<td>1.3 ±0.5</td>
<td>1.7 ±0.6</td>
<td>0.03</td>
</tr>
</tbody>
</table>
Quality of life following lung cancer resection
Li et al, Chest, 122: 584-89, 2002

- Retrospective cross-sectional study of 136 patients who underwent lung resection between 1994 and 2000
- 85 patients were excluded based on tumor size, locally advanced disease, use of adjuvant therapy, or co-existing illnesses
- Allowed comparisons of 27 patients who underwent VATS lobectomy with 24 patients who underwent thoracotomy to treat lung cancer
Quality of life following lung cancer resection
Li et al, Chest, 122: 584-89, 2002

• Mean follow-up time 33.5 months in the VATS group and 39.4 months in the thoractomy group
• All patients were questioned using the EORTC QLC-LC13
• Patients reported reasonable QOL scores in both the VATS (65.4 ±18.3) and thoractomy (56.6 ±22.1) groups (P=NS)
• No statistical differences were identified between the VATS and thoracotomy groups for functioning scale, symptom scores, or satisfaction with surgery
Prospective comparison between 10 patients undergoing VATS lobectomy and 11 patients undergoing thoracotomy for lung cancer

SaO2, PaO2 and PFr were transiently improved in the VATS group

FEV1 in the perioperative period was no different

No difference was seen between the groups at one year follow-up
Cost of VATS versus open resection for patients with lung carcinoma
Nakajima et al, Cancer 89: 2497-501, 2000

• Retrospective review of 102 patients undergoing resection for lung cancer in Tokyo, Japan
  – Thoracotomy 66
  – VATS 36

• Mean hospital charge $11,348
  – Surgical fee and anesthesia fee accounted for 50% of the charge
Cost of VATS versus open resection for patients with lung carcinoma
Nakajima et al, Cancer 89: 2497-501, 2000

<table>
<thead>
<tr>
<th></th>
<th>Thoracotomy</th>
<th>VATS</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N= 66</td>
<td>N=33</td>
<td></td>
</tr>
<tr>
<td>Lobectomy</td>
<td>65</td>
<td>14</td>
<td>NS</td>
</tr>
<tr>
<td>Segmentectomy</td>
<td>1</td>
<td>22</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LOS</td>
<td>23.8 ±7.8</td>
<td>17.3 ±7.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lab</td>
<td>$1335 ± 632</td>
<td>$990 ±529</td>
<td>0.006</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>$1853 ± 416</td>
<td>$1534 ±309</td>
<td>0.004</td>
</tr>
<tr>
<td>Disposable equipment</td>
<td>$573 ± 423</td>
<td>0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Total charges</td>
<td>$12178 ± 3877</td>
<td>$9825 ±2296</td>
<td>0.0012</td>
</tr>
</tbody>
</table>
Summary

• VATS is a safe and effective treatment option for patients with EARLY stage lung cancer

• No prospective randomized trials exist to adequately compare VATS to thoracotomy

• No information has been presented about the “learning curve” needed to acquire the skills for VATS lobectomy