Lung Screening and Radiation for Early Stage Disease

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ZABLOCKI VA MEDICAL CENTER
APRIL 6, 2016
Objectives

Risk factors for lung cancer
Who should be screened
Benefits
Risks
Implications of a positive screen
Management
Lung Cancer Screening

High prevalence

High morbidity and Mortality

Known Risk factors

Evidence that treatment is more effective with early diagnosis
In 2015, 158,040 Americans are expected to die from lung cancer.
Lung cancer
Risk Factors

Smoking
Radon Exposure
Occupational Exposure
Cancer History
Family History 1\textsuperscript{st} degree relative
COPD or pulmonary fibrosis
Second hand smoke
Risk Categories

High Risk
- Age 55-74
- ≥ 30 pack year
- Smoking cessation < 15 years
- OR
- Age ≥ 50
- ≥ 20 pack year
- 1 additional Risk factor other than SHS exposure
Risk Categories

Moderate
◦ Age ≥ 50
◦ ≥ 20 pack year
◦ 1 additional Risk factor or SHS exposure
◦ No other risk factors

Low Risk
◦ Age < 50
◦ < 20 pack year
Advanced Vs Early Stage
### Lung Cancer Staging

<table>
<thead>
<tr>
<th>T/M</th>
<th>Subgroups</th>
<th>N0</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
</tr>
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<tbody>
<tr>
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<td>IIIIB</td>
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<td>IV</td>
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</table>
Lung Cancer Survival by Stage

<table>
<thead>
<tr>
<th>Stage</th>
<th>Deaths</th>
<th>N</th>
<th>Months</th>
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<tbody>
<tr>
<td>IA</td>
<td>135</td>
<td>281</td>
<td>58</td>
</tr>
<tr>
<td>IB</td>
<td>229</td>
<td>424</td>
<td>42</td>
</tr>
<tr>
<td>IIA</td>
<td>79</td>
<td>146</td>
<td>46</td>
</tr>
<tr>
<td>IIB</td>
<td>525</td>
<td>755</td>
<td>19</td>
</tr>
<tr>
<td>IIIA</td>
<td>818</td>
<td>1072</td>
<td>14</td>
</tr>
<tr>
<td>IIIB</td>
<td>225</td>
<td>257</td>
<td>10</td>
</tr>
<tr>
<td>IV</td>
<td>889</td>
<td>928</td>
<td>6</td>
</tr>
</tbody>
</table>
Lung Cancer Screening

CXR has been studied for screening with no survival advantage
CAT Scans are more sensitive
Lung Cancer Screening
CXR versus CT
## CXR vs CT Radiation Dose

<table>
<thead>
<tr>
<th>Source of exposure</th>
<th>Dose in rem</th>
<th>Dose in sievert (Sv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure to cosmic rays during a roundtrip airplane flight from New York to Los Angeles</td>
<td>3 mrem</td>
<td>0.03 mSv</td>
</tr>
<tr>
<td>One dental x-ray</td>
<td>4–15 mrem</td>
<td>0.04–0.15 mSv</td>
</tr>
<tr>
<td>One chest x-ray</td>
<td>10 mrem</td>
<td>0.1 mSv</td>
</tr>
<tr>
<td>One mammogram</td>
<td>70 mrem</td>
<td>0.7 mSv</td>
</tr>
<tr>
<td>One year of exposure to natural radiation (from soil, cosmic rays, etc.)</td>
<td>300 mrem</td>
<td>3 mSv</td>
</tr>
</tbody>
</table>

- **Standard CT**: 8 mSv
- **LDCT (screening)**: 1.5 mSv
- **Annual dose airline personnel**: 2.19 mSv
Low Dose vs Standard CT
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

National Lung Screening Trial (NLST)

- N= 53,454 current or former cigarette smokers
- LDCT vs. CXR yearly for three years

Median follow-up 6.5 years

Inclusion criteria: HIGH RISK GROUP

- Current or former cigarette smokers (stopped within the past 15 years)
- 55 to 74 years of age
- At least 30 pack-years of smoking
- No symptoms or signs of lung cancer or other conditions that would make them unfit for surgery
Results - Benefits

CT study group
- 354 out of 26,722 died from lung cancer (18 out of every 1000 studied)

CXR study group
- 442 out of 26,732 died from lung cancer (21 out of every 1000 studied)

THUS

88 fewer people in the CT group died of lung cancer, compared to the CXR group

A reduced relative lung cancer mortality rate of 20%
Results - Harms

False Positive 96.5% (CT), 94.5% (CXR)

90% of false positive results required at least one diagnostic procedure

Major Adverse Events

- CT 11.6%
  - 0.06% did not have lung cancer
  - 1.5% death within 60 days of procedure

- CXR 8.6%
  - 0.02% did not have lung cancer
  - 3.9% death within 60 days of procedure
PET
Diagnosis
Cost

1 CT scan

= 27 packs of cigarettes

= 1 month of tobacco consumption

= 2.5 months of nicotine substitutes
Lung Cancer Screening Is a Program Not a Test

Who is offered lung cancer screening
How often, and for how long to screen
How the CT is performed
Lung nodule identification
Structured reporting
Lung nodule management algorithms
Smoking cessation
Patient and provider education
Data collection

Mazzone P, Chest 2015, 147: 295-303
How to Follow Lung Nodules?

NCCN Guidelines Version 1.2015
Lung Cancer Screening

EVALUATION OF SCREENING FINDINGS

- <6 mm: Annual LDCT for 2 years (category 1) and suggest annual LDCT until patient no longer eligible for definitive treatment

- 6-8 mm: LDCT in 3 mo

- Solid or part-solid nodule: Consider PET/CT

- >8 mm: If no increase in size, LDCT in 6 mo

- Low suspicion of lung cancer: LDCT in 3 mo

- Suspicion of lung cancer: Biopsy or Surgical excision

- Solid endobronchial nodule: LDCT in 1 mo (immediately after vigorous coughing)

- If no resolution: Bronchoscopy

- Annual LDCT for 2 years (category 1) and suggest annual LDCT until patient is no longer eligible for definitive treatment

- Surgical excision: See appropriate NCCN Guidelines
Management of Lung Cancer
Management of Early Stage Lung Cancer

Surgery

SBRT—Stereotactic Body Radiation Therapy
Non-Surgical Management of Early Stage Lung Cancer
Features of SBRT

- Accounting for Motion
  - 4D Planning

- Small tumour volumes
  - Small margins

- Many Beam Directions
  - 7-11 Beams / Arc Therapy

- Steep dose gradients
  - Inhomogeneous target dose

- Accurate Targeting
  - CBCT pre-RT

- High dose per fraction
  - Short total treatment duration
Image Guided Radiation Therapy
RTOG 0236

Stereotactic Body Radiation Therapy for Inoperable Early Stage Lung Cancer

> 95% local control

Timmerman et al. JAMA. 2010;303(11):1070-1076
Stage I–II non-small-cell lung cancer treated using either stereotactic ablative radiotherapy (SABR) or lobectomy by video-assisted thoracoscopic surgery (VATS): outcomes of a propensity score-matched analysis
STABLEMATES Trial Schema

1. Defined High Risk Stage I NSCLC
2. Screen Eligible Patients/Pre-Randomize
3. Consent to Accept Randomization Assignment

N = 272

Accept: Arm 1: Sublobar Resection N = 109
Accept: Arm 2: SAbR N = 109

Follow for OS, Toxicity, and Patterns of Failure

Reject: Consent to Be Observed After Standard of Care Therapy
N = 48

Follow for OS and Patterns of Failure

Reject: Failure to Consent (Off Study)
N = 6*

N = 54*
Central vs Peripheral Tumors
Conclusions

Lung cancer Screening saves lives

Screening is a program should involve education and mitigation of risk factors
  ◦ Smoking cessation

Primary treatment is surgery early stage lung cancer

Stereotactic radiation is an excellent alternative for patients who cannot have surgery or decline
Minimally Invasive Surgical Treatment Options for Lung Cancer

Deemy Rekkas, MD, FACS
CardioThoracic Surgery
History of Lung Cancer

• The most salient point in the history of lung cancer is that it was almost non-existent before the twentieth century.

• Adler reported 221 collected cases to 1900 and 374 to 1912

• Cigarette smoking as etiology first suspected by Soemmerling.
Epidemiology of Lung Cancer

- Estimated U.S. incidence in 2015: 221,200 cases/year
- 158,040 deaths in men and women

<table>
<thead>
<tr>
<th>Cause</th>
<th>Males</th>
<th>Females</th>
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<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>86,380</td>
<td>71,660</td>
</tr>
<tr>
<td>Prostate</td>
<td>27,540</td>
<td>40,290</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>26,100</td>
<td>23,600</td>
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<tr>
<td>Pancreas</td>
<td>20,710</td>
<td>19,850</td>
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<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>17,030</td>
<td>14,180</td>
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<tr>
<td>Leukemia</td>
<td>14,210</td>
<td>10,240</td>
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<tr>
<td>Esophagus</td>
<td>12,600</td>
<td>10,170</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>11,510</td>
<td>8,310</td>
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<tr>
<td>Non-Hodgkin lymphoma</td>
<td>11,480</td>
<td>7,520</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>9,070</td>
<td>6,380</td>
</tr>
<tr>
<td><strong>All Sites</strong></td>
<td><strong>312,150</strong></td>
<td><strong>277,280</strong></td>
</tr>
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</table>

Robotic surgery and Cancer
# U.S. Mortality, 2006

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>No. of deaths</th>
<th>% of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Heart Diseases</td>
<td>631,636</td>
<td>26.0</td>
</tr>
<tr>
<td>2.</td>
<td>Cancer</td>
<td>559,888</td>
<td>23.1</td>
</tr>
<tr>
<td>3.</td>
<td>Cerebrovascular diseases</td>
<td>137,119</td>
<td>5.7</td>
</tr>
<tr>
<td>4.</td>
<td>Chronic lower respiratory diseases</td>
<td>124,583</td>
<td>5.1</td>
</tr>
<tr>
<td>5.</td>
<td>Accidents (unintentional injuries)</td>
<td>121,599</td>
<td>5.0</td>
</tr>
<tr>
<td>6.</td>
<td>Diabetes mellitus</td>
<td>72,449</td>
<td>3.0</td>
</tr>
<tr>
<td>7.</td>
<td>Alzheimer disease</td>
<td>72,432</td>
<td>3.0</td>
</tr>
<tr>
<td>8.</td>
<td>Influenza &amp; pneumonia</td>
<td>56,326</td>
<td>2.3</td>
</tr>
<tr>
<td>9.</td>
<td>Nephritis*</td>
<td>45,344</td>
<td>1.9</td>
</tr>
<tr>
<td>10.</td>
<td>Septicemia</td>
<td>34,234</td>
<td>1.4</td>
</tr>
</tbody>
</table>

*Includes nephrotic syndrome and nephrosis.

Lung Cancer

• #1 Killer of all cancers
  – Surpasses breast, prostate, colorectal cancer
  – The most common cancer, worldwide
  – Overall, cancer #2 killer after heart disease in US

• No lung cancer before smoking!!!!!!
Smoking Kills

The first owner of the MARLBORO company died of...

LUNG CANCER

...and so did the first MARLBORO MAN
5/6 of Marlboro Men died of Lung Cancer

The Marlboro Man on his Deathbed

And it is on to “Horse Heaven” in the skies

Wayne McLaren, 1970s

This is the reason you don’t see any more Marlboro Men.

And due to this 2nd hand smoke here are the last seconds of life for the Marlboro Man’s horse.

5 of the last 6 Marlboro Men died of smoking related cancers. And a few months later, their horses died of 2nd hand smoke, oh!

His last words, after spending his last month in an incubator: “Tobacco will kill you. I’m dying proof of it.”

While a government ban couldn’t kill the Marlboro Man, the instrument that ended it up doing the trick was the product itself. Two Marlboro men, Wayne McLaren and David McLean, died of lung cancer, but not before McLaren could testify in favor of anti-smoking legislation.
Lung Cancer Risk

10-15% never smoked
about 50% used to smoke
<40% currently smoke

94 Million Current and Former Smokers in the US

© 2014 Free to Breathe
Based on guidelines such as:

- ACCP 2013
- ESMO 2014
- NCCN 2015
<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Treatment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>Tumor of any size is found only in the lung</td>
<td>Surgery</td>
</tr>
<tr>
<td>Stage II</td>
<td>Tumor has spread to lymph nodes associated with the lung</td>
<td>Surgery</td>
</tr>
<tr>
<td>Stage III a</td>
<td>Tumor has spread to the lymph nodes in the tracheal area, including chest wall and diaphragm</td>
<td>Chemotherapy followed by radiation or surgery</td>
</tr>
<tr>
<td>Stage III b</td>
<td>Tumor has spread to the lymph nodes on the opposite lung or in the neck</td>
<td>Combination of chemotherapy and radiation</td>
</tr>
<tr>
<td>Stage IV</td>
<td>Tumor has spread beyond the chest</td>
<td>Chemotherapy only</td>
</tr>
</tbody>
</table>
Non Small Cell Lung Cancer Surgery

Stage 1A:
- Lobectomy treatment of choice
- T1N0 70%/5 year recurrence free survival after lobectomy
- If inoperable
- 30% cure rate with xrt only/sbRT/cyberknife

Stage 1B:
- Lobectomy treatment
- Adjuvant chemotherapy adds 4-12% survival benefit, best in tumors >4cm
Stage 2

- Lobectomy treatment of choice
- Adjuvant chemotherapy now standard
- Consider adjuvant xrt to mediastinum

Stage 3

- Combination treatment with chemo/XRT treatment of choice
- Surgery has yet to be established as benefit consistently in randomized trials
- Neoadjuvant therapy followed by surgery an option in 3A
  - Debate about chemo vs chemo/xrt

NCCN guidelines used for treatment
Multidisciplinary tumor conference
History of Lung Cancer Surgery

Lothar Heidenhain
First resection of a lung cancer
1903
(incidental in lobectomy for bronchiectasis)

Everts Graham
Pneumonectomy
1932
Cautery Pneumectomy
Evolution of Lung Surgery

• Open thoracotomy- gold standard
• Muscle sparing thoracotomy
• Smaller incision thoracotomy
  – VATS - video assisted thoracotomy - Still rib spreading
• **VATS – video assisted thoracoscopy (VATS)**
  – non rib spreading, variations of incisions, uniportal to 5 small incisions
  – “Key-hole surgery”
• **Robotic assisted thoracic surgery (RATS)**

**only VATS and RATS truly minimally invasive**
Thoracotomy
Thoracotomy
Thoracotomy
The Traditional Approach

Open Thoracotomy
The Traditional Approach

Open Thoracotomy
Brief Clinical Report

Videoendoscopic Pulmonary Lobectomy for Cancer

Giancarlo Roviaro, M.D., Carlo Rebuffat, M.D., Federico Varoli, M.D.,
Contardo Vergani, M.D., Claudio Mariani, M.D., and Marco Maciocco, M.D.

"Utility thoracotomy"


PROHEALTH CARE
Thoracoscopy assisted pulmonary lobectomy

W S Walker, F M Carnochan, M Tin

Thorax 1993;48:921–924
VATS Lobectomy
VATS Lobectomy
VATS Lobectomy
Thoracotomy vs VATS
Oncological Comparison
VATS vs Thoracotomy

• No difference in lymph node dissection

• No difference in survival curves
  o Some studies report trends in increased survival
  o VATS approach does not compromise patient survival
Results in the Literature

Advantages of VATS approach

• Less Postoperative pain

• Shorter length of stay
  o Reduced air leaks/length of chest tube placement
  o Reduced overall hospital cost

• Faster recovery/return to normal activities

• Better postoperative pulmonary function

• More likely to complete postoperative chemotherapy
Thoracoscopic Lobectomy Facilitates the Delivery of Chemotherapy after Resection for Lung Cancer

Rebecca P. Petersen, MD, MS, DuyKhanh Pham, MD, William R. Burfeind, MD, Steven I. Hanish, MD, Eric M. Toloza, MD, PhD, David H. Harpole, Jr, MD, and Thomas A. D’Amico, MD

<table>
<thead>
<tr>
<th>Compliance</th>
<th>Thoracoscopy n = 57 (%)</th>
<th>Thoracotomy n = 43 (%)</th>
<th>p Value</th>
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</thead>
<tbody>
<tr>
<td>Time to initiation of chemo (days)</td>
<td>58 ± 31</td>
<td>54 ± 35</td>
<td>0.277</td>
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<tr>
<td>Percentage of planned regimen received</td>
<td>88% ± 24%</td>
<td>89% ± 19%</td>
<td>0.835</td>
</tr>
<tr>
<td>Pts with delayed chemotherapy doses</td>
<td>10 (18)</td>
<td>25 (58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pts with reduced chemotherapy doses</td>
<td>15 (26)</td>
<td>21 (49)</td>
<td>0.020</td>
</tr>
<tr>
<td>&gt;75% of total planned regimen</td>
<td>35 (61)</td>
<td>17 (40)</td>
<td>0.030</td>
</tr>
<tr>
<td>Toxicity grade ≥2</td>
<td>29 (51)</td>
<td>24 (56)</td>
<td>0.624</td>
</tr>
<tr>
<td>Toxicity grade ≥3</td>
<td>7 (12)</td>
<td>9 (21)</td>
<td>0.243</td>
</tr>
</tbody>
</table>

VATS Lobectomy Has Better Perioperative Outcomes Than Open Lobectomy: CALGB 31001, an Ancillary Analysis of CALGB 140202 (Alliance)

Chukwumere E. Nwogu, MD, PhD, Jonathan D'Cunha, MD, PhD, Herbert Pang, PhD, Lin Gu, MS, Xiaofei Wang, PhD, William G. Richards, PhD, Linda J. Veit, MPH, Todd L. Demmy, MD, David J. Sugarbaker, MD, Leslie J. Kohman, MD, and Scott J. Swanson, MD, for the Alliance for Clinical Trials in Oncology

Background. The short-term superiority of video-assisted thoracoscopic surgery lobectomy compared with open lobectomy for early-stage lung cancer has been suggested by single-institution studies. Lack of equipoise limits the feasibility of a randomized study to confirm this. The hypothesis of this study (CALGB 31001) was that VATS lobectomy results in shorter length of hospital stay and fewer complications compared with open lobectomy in stages I and II non-small cell lung cancer in a multi-institutional setting.

Methods. Five hundred nineteen patients whose tumors had been collected as part of CALGB 140202 (lung cancer tissue bank) were eligible. Propensity-scorning using age, race, sex, performance status, comorbidities, histology, tumor stage, and size as independent variables was used to create a 1:1 matched group of 175 pairs of patients. McNemar's test for binary variables and Wilcoxon signed-rank test for continuous variables were used to assess differences in length of hospital stay, complications, and discharge dispositions between the groups. Comparison of disease-free and overall survival between the two approaches was done using the log-rank test. Probability values of less than 0.05 were considered significant.

Results. The matched data on length of hospital stay, complications, and discharge dispositions significantly favored the video-assisted thoracoscopic surgery group. There was no statistically significant difference in survival between the two approaches.

Conclusions. This multi-institutional study supports the assertion that thoracoscopic lobectomy results in shorter hospital length of stay, fewer perioperative complications, and greater likelihood of independent home discharge compared with open lobectomy for early-stage lung cancer. Survival was comparable between the two groups.

Video-assisted thoracoscopic pneumonectomy

W. S. WALKER, F. M. CARNOCHAN and S. MATTAR

Department of Thoracic Surgery, City Hospital, Greenbank Drive, Edinburgh EH10 5SB, UK
Correspondence to: Mr W. S. Walker

Video-assisted thoracoscopic left pneumonectomy is reported. The patient was fully ambulant at 48 h, had much less pain than after standard thoracotomy and was discharged home on the fifth day after operation.

British Journal of Surgery 1994, 81, 81–82
Robotics for Thoracic Surgery
The Dilemma of VATS

Data from The Society of Thoracic Surgeons General Thoracic Surgery database: The surgical management of primary lung tumors

Daniel J. Boffa, MD, a Mark S. Allen, MD, b Joshua D. Grab, c Henning A. Gaissert, MD, d David H. Harpole, MD, e and Cameron D. Wright, MD f

- 1999-2006
- 6042 lobectomies
  - 1040 VATS (17%)
  - Upwards trend (32% in 2006)

Boffa et al., 2008
Paul et al., 2013
Minimally Invasive Lung Surgery

- Approximately 20-35% of lobectomies in the US are done using minimally invasive approach (VATS or robotic)

- Rest still done open
Da Vinci Robot
Advantages to Using the Da Vinci Robot

- 3-D, high definition visualization with 10x magnification
- Wristed instrumentation
- “Intuitive” movement
Robotics for Thoracic Surgery
VATS

- Wedge
- Segmentectomy
- Lobectomy
- Pneumonectomy
- Thymectomy (other mediastinal masses)
- Esophagectomy
- Decortication/Pleurodesis
- Sympathectomy
- Diaphragm plication
Robotic Right Upper Lobectomy

- Port Placement
- Transection of right superior pulmonary vein
- Transection of minor fissure
- Removal of hilar and interlobar lymph nodes (10r, 11R) and superior mediastinal lymph nodes

Robotics for Thoracic Surgery
VATS vs. Open Lobectomy

- Fewer complications
- Shorter lengths of stay
- Faster return to work
- Less pain
- Decreased overall cost
- Improved delivery of chemotherapy

Paul et al., 2010
Scott et al., 2010
McKenna et al., 2006
Burfeind et al., 2010
Petersen et al., 2007
# Robotic Lobectomy Reduces Length of Stay, Morbidity, and Mortality

<table>
<thead>
<tr>
<th>Study (n)</th>
<th>Comparator</th>
<th>LOS, days (p value vs. robotic)</th>
<th>Chest tube duration, days (p value vs. robotic)</th>
<th>Overall Complications % (p value vs. robotic)</th>
<th>30 day Mortality % (p value vs. robotic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kent 2013¹</td>
<td>Open (1,233)</td>
<td>8.2 (&lt;.0001)</td>
<td>NA</td>
<td>54.1 (.003)</td>
<td>2.0 (.016)</td>
</tr>
<tr>
<td>VATS (1,233)</td>
<td>SID (national database)</td>
<td>6.3 (NS)</td>
<td>NA</td>
<td>45.3 (NS)</td>
<td>1.1 (NS)</td>
</tr>
<tr>
<td>Robotic (411)</td>
<td></td>
<td>5.9</td>
<td>NA</td>
<td>43.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Farivar 2014²</td>
<td>Open (4,612)</td>
<td>7.3 (&lt;.0001)</td>
<td>4.8 (&lt;.0001)</td>
<td>NA</td>
<td>2.0 (&lt;.0001)</td>
</tr>
<tr>
<td>VATS (5,913)</td>
<td>STS database</td>
<td>5.3 (&lt;.0001)</td>
<td>3.7 (.0005)</td>
<td>NA</td>
<td>0.9 (&lt;.0001)</td>
</tr>
<tr>
<td>Robotic (181)</td>
<td>2 centers</td>
<td>3.2</td>
<td>2.9</td>
<td>NA</td>
<td>0</td>
</tr>
<tr>
<td>Cerfolio 2011³</td>
<td>Open (318)</td>
<td>4.0 (.02)</td>
<td>3.0 (&lt;.001)</td>
<td>38.0 (.05)</td>
<td>3.0 (NS)</td>
</tr>
<tr>
<td>Robotic (106)</td>
<td>Single center</td>
<td>2.0</td>
<td>1.5</td>
<td>27.0</td>
<td>0</td>
</tr>
</tbody>
</table>

Robotic Lobectomy Increases Nodal Upstaging

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Hilar upstaging % (p value vs. VATS)</th>
<th>Mediastinal upstaging % (p value vs. VATS)</th>
<th>Overall upstaging % (p value vs. VATS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boffa 2012¹</td>
<td></td>
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<tr>
<td>Open</td>
<td>7,137</td>
<td>9.3 (&lt;.001)</td>
<td>5.0 (NS)</td>
<td>14.3 (&lt;.001)</td>
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<tr>
<td>VATS</td>
<td>4,394</td>
<td>6.7</td>
<td>4.9</td>
<td>11.6</td>
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<tr>
<td>Licht 2013²</td>
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<td></td>
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<tr>
<td>Open</td>
<td>796</td>
<td>13.1 (&lt;.001)</td>
<td>11.5 (&lt;.001)</td>
<td>24.6 (&lt;.001)</td>
</tr>
<tr>
<td>VATS</td>
<td>717</td>
<td>8.1</td>
<td>3.8</td>
<td>11.9</td>
</tr>
<tr>
<td>Merritt 2013³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>69</td>
<td>17.4 (NS)</td>
<td>7.2 (NS)</td>
<td>24.6 (.05)</td>
</tr>
<tr>
<td>VATS</td>
<td>60</td>
<td>8.3</td>
<td>1.8</td>
<td>10</td>
</tr>
<tr>
<td>Park 2012⁴</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Robotic</td>
<td>325</td>
<td>NR</td>
<td>NR</td>
<td>24.0 (N/A)</td>
</tr>
</tbody>
</table>

When is open vs VATS vs RATS is preferred for early stage NSCLC?

- ACCP 2013: For stage I NSCLS, MIS such as VATS is preferred over a thoracotomy and is suggested in experienced centers.
- ESMO 2014: Either open or VATS access can be utilized as appropriate to the expertise of the surgeon.
- NCCS 2015: VATS/MIS/RATS should be strongly considered as long as there is no compromise of standard oncologic and dissection principles.
- In high VATS volume center, VATS is better than open regarding: pain, hospital stay, time return to function, complications occurred.
Dr. Deemy Rekkas

Number of cases

- Q2 2015 - 9 cases
- Q3 2015 - 5 cases
- Q4 2015 - 10 cases
- Q1 2016 - 19 cases
WMH STATE RANKINGS - PROCEDURE VOLUME

39 TOTAL DV PROGRAMS IN WI

WMH IS THE BUSIEST ROBOTIC PROGRAM IN SE WI

DV GENERAL SURGERY PROGRAM IN 2015 # 3

DV GYN SURGERY PROGRAM IN 2015 # 4

DV ENT SURGERY PROGRAM IN 2015 # 1

DV THOR SURGERY PROGRAM IN 2015 # 3

DV URO SURGERY PROGRAM IN 2015 # 12
da Vinci Thoracic Stapling – 18min 42sec

da Vinci Thoracic Node Dissection – 20sec

da Vinci Thoracic Suturing – 10min
Questions?