Thoracic Surgery in the 21st Century = More Appropriate Care

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Surgical Director Thoracic Center at Virginia Mason
Lacey, WA
5/4/2019
Disclosures

• No financial or commercial interest disclosures
Outline

• Esophagus
• Lung
• Local Care versus Regional Care
• Next time: Pleura, Mediastinum, Chest Wall
Esophagus

- **Dysphagia**
- Having pain while swallowing (odynophagia)
- Being unable to swallow
- Having the sensation of food getting stuck in your throat or chest or behind your breastbone (sternum)
- Drooling
- Being hoarse
- Bringing food back up (regurgitation)
- Having frequent heartburn
- Having food or stomach acid back up into your throat
- Unexpectedly losing weight
- Coughing or gagging when swallowing
Achalasia.
GERD/ PARAESOPHAGEAL HERNIA
Diffuse spasm.
Esophageal stricture.
Esophageal tumors.
Foreign bodies.
Esophageal ring
Esophageal Diverticula
Eosinophilic esophagitis.
Scleroderma.
Radiation therapy.
Achalasia - lower esophageal muscle doesn't relax

- Barium Esophagram
- Upper endoscopy
- Esophageal manometry
  - Lower Esophageal Sphincter
    - Mid LES (from nares) (cm): 45
    - Resting pressure minimum (NL: 4.8-32.0 mm Hg): 13
    - Resting pressure mean (NL: 13-43 mm Hg): 19
    - Integrated relaxation pressure (NL < 15 mmHg): 21.6
  - Hiatal Hernia: _ yes, _ size (cm)
    - x no
  - Esophageal Motility
    - Number of swallows evaluated: 10
    - There was complete aperistalsis. Minimum panesophageal peristalsis in supine swallows.
    - Multiple swallows revealed panesophageal pressurization along with incomplete LES relaxation.
  - Upper Esophageal Sphincter
    - Relaxation pressure (NL < 12 mmHg): 6
  - Impression:
    - Abnormal manometric findings are consistent with type I achalasia.
Achalasia – Treatment Options

- Endoscopic Dilation
- Botox injection into LES
- Heller Myotomy
- Peroral Endoscopic Myotomy
Surgery or Peroral Esophageal Myotomy for Achalasia: A Systematic Review and Meta-Analysis

Luigi Marano, MD, PhD, Giovanni Pallabazzer, MD, Biagio Solito, MD, Stefano Santi, MD, Alessio Pigazzi, MD, PhD, Raffaele De Luca, MD, Francesco Giuseppe Biondo, MD, Alessandro Spaziani, MD, Maurizio Longaroni, MD, Natale Di Martino, MD, Virginia Boccardi, MD, PhD, and Alberto Patriti, MD, PhD
GERD/Anatomy of the EG Junction
Indications For Surgery

Gastrointestinal indications
• Failed optimal medical management
• High volume reflux
• Severe esophagitis by endoscopy
• Barrett's columnar-lined epithelium (without severe dysplasia or carcinoma)

Non-Gastrointestinal indications
• Asthma
• IPF – pretransplant
• Noncompliance with medical therapy
Is the Diagnosis Correct?

- Normal Stomach
- Nissen Fundoplication
- Heller Myotomy for Achalasia
- Paraesophageal Hernia
PREOPERATIVE EVALUATION

• Upper endoscopy
• Esophageal manometry
• Esophagram
• 24hr pH or Bravo
• Gastric Emptying
• Pulmonary Function Tests
• Cardiology Evaluation
Hiatal/Paraesophageal Hernia

**Symptoms:**
- Dysphagia
- Food Regurgitation
- Retrosternal Pain
- Dyspnea
- Anorexia
Paraesophageal hernia/GERD Evaluation

- **Upper Endoscopy**
- pH study
- Esophagram
- Esophageal Manometry

**Reflux Medications:**
- Yes  Medication/dose: _
- No

**Esophageal pH Sensor**
- Fraction Time pH <4: 21.6% (NL < 4.5)
- Upright Position: 20% (NL < 8.4)
- Supine Position: 22.8% (NL < 3.5)
- # Reflux Episodes > 5 minutes: 10 (NL < 5)
- Longest Reflux Episode: 45 minutes

**Gastric pH Sensor**
- Fraction Time pH <4: 97.4%
- DeMeester Score: 79.1 (NL < 14.72)

**Symptom Correlation**
- Patient reported 5 episodes of chest pain, all of the episodes were related to acid reflux (SI 100%, SAP 98.6%).

**Lower Esophageal Sphincter**
- Mid LES (from nares) (cm): 44
- Resting pressure minimum (NL 4.8-32.0 mm Hg): 0
- Resting pressure mean (NL 13-43 mmHg): 9
- Integrated relaxation pressure (NL < 15 mmHg): 3
- Hiatal Hernia: x yes, 2.5 size (cm) _ no

**Esophageal Motility**
- Number of swallows evaluated: 10
- Distal contractile integral mean (NL 500-8000 mmHg-cm-s): 1776
- Distal contractile integral Max (mmHg-cm-s): 2577
- Distal latency mean (NL > 4.5 s): 5.8
- Peristaltic contractions 100%
  - Weak peristalsis (DCI < 450 mmHg-cm-s) 10%
  - Large breaks 0%
- Failed 0%
- Multiple swallows: intact x yes _ no

**Upper Esophageal Sphincter**
- Relaxation pressure (NL < 12 mmHg): 0

**Impression:**
- Hypotensive LES pressure with normal relaxation
- Normal peristalsis
- Normal UES relaxation
- Hiatus hernia

**Upper Endoscopy**
- pH study
- Esophagram
- Esophageal Manometry
Paraesophageal Hernia Evaluation
Choice of Operation

- Laparotomy versus Laparoscopy
- Type of antireflux operation
- Nissen - 360 degree fundic wrap
- Toupet - partial 270 degree posterior wrap
- Dor - partial 180 degree anterior wrap
- Hill - involves imbrication of the anterior and posterior lesser gastric curve around the esophagus with tethering of the complex to the median arcuate ligament and closure of the diaphragm
- Esophageal anchoring/lengthenting – Collis gastroplasty
- Prosthesis (Angelchik - a doughnut-shaped prosthesis placed around the distal esophagus, LINX – series of magnetic beads)
Choice of Operation

- Laparotomy versus Laparoscopy
- Type of antireflux operation
  - Nissen
  - Toupet
  - Dor
  - Hill
  - Esophageal anchoring/lengthenting
  - Prosthesis

Variables

- Esophageal Motility
- Esophageal length/Location of EG junction
- Gastric Motility
- Presence of Paraesophageal hernia
- Previous surgery
Risks of Surgery

- Injury to esophagus
- Division of the Vagus Nerves – gastroparesis
- Injury to adjacent organs (Liver, spleen, heart, lungs)
- Gastric herniation through the fundoplication
- Disruption of fundoplication

**Side Effects:** Gastric bloat, flatulence, dysphagia
Treatment Options
Esophageal Cancer
Esophageal Cancer Staging

[Diagram of esophageal cancer staging with an Esophagus Staging Form table]

**Esophagus Staging Form**

<table>
<thead>
<tr>
<th>CLINICAL</th>
<th>PATHOLOGIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of disease before any treatment</td>
<td>Extent of disease through completion of definitive surgery</td>
</tr>
</tbody>
</table>

**STAGE CATEGORY DEFINITIONS**

<table>
<thead>
<tr>
<th>TUMOR SIZE:</th>
<th>LATERALITY:</th>
<th>PRIMARY TUMOR (T)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TX: Primary tumor cannot be assessed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T0: No evidence of primary tumor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T1a: Tumor invades lamina propria, muscularis mucosae, or submucosa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T1b: Tumor invades lamina propria or muscularis mucosae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T2: Tumor invades submucosa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T3: Tumor invades muscularis propria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T4: Tumor invades adventitia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T4a: Tumor invades adjacent structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T4b: Tumor invades other adjacent structures, such as aorta, vertebral body, trachea, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>(High-grade dysplasia includes all non-invasive neoplastic epithelium that was formerly called carcinoma in situ, a diagnosis that is no longer used for columnar mucosa anywhere in the gastrointestinal tract)</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>REGIONAL LYMPH NODES (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX: Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0: No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1: Regional lymph node metastasis involving 1 to 2 nodes</td>
</tr>
<tr>
<td>N2: Regional lymph node metastasis involving 3 to 6 nodes</td>
</tr>
<tr>
<td>N3: Regional lymph node metastasis involving 7 or more nodes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISTANT METASTASIS (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0: No distant metastasis (no pathologic M0; use clinical M to complete stage group)</td>
</tr>
<tr>
<td>M1: Distant metastasis</td>
</tr>
</tbody>
</table>
Lung Cancer

• Screening
• Surgery for Lung Cancer
• Multidisciplinary Management
• Pulmonary Nodule Board
• Tumor Board
Leading Cause of Cancer Death

Estimated Cancer Deaths by Site, 2014

- Pancreas
- Breast
- Colorectal
- Lung & Bronchus

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Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

ABSTRACT

BACKGROUND

The aggressive and heterogeneous nature of lung cancer has thwarted efforts to reduce mortality from this cancer through the use of screening. The advent of low-dose helical computed tomography (CT) altered the landscape of lung-cancer screening, with studies indicating that low-dose CT detects many tumors at early stages. The National Lung Screening Trial (NLST) was conducted to determine whether screening with low-dose CT could reduce mortality from lung cancer.

The members of the writing team (who are listed in the Appendix) assume responsibility for the integrity of the article. Address reprint requests to Dr. Christine D. Berg at the Early Detection Research Group, Division of Cancer Prevention, National Cancer Institute, 6130 Executive Blvd, Suite 3132, Rockville, MD 20852.
NNT = 320
Lung Cancer screening

Seattle Lung Cancer Screening

- 2013: 0
- 2014: 1
- 2015: 6
- 2016: 488
- 2017: 811
- 2018: 607

- number of scans
- number of cancers

- 10000 eligible
- 500 screened

Washington State Map

- 10000 eligible
- 500 screened
Surgery for Lung Cancer

• When is it appropriate?
• How is it done?
• What are the outcomes?
• Surgery versus radiation?
• Patient centered approach at our Chest Center!
STAGE I

LOCAL THERAPY
STAGE II

LOCAL → SYSTEMIC THERAPY
STAGE IIIA

SYSTEMIC → LOCAL THERAPY
STAGE IIIB/C

SYSTEMIC THERAPY

STAGE IV
N2 Disease in T1 Non-Small Cell Lung Cancer
Sebastian A. Defranchi, MD, Stephen D. Cassivi, MD, MS, Francis C. Nichols, MD, Mark S. Allen, MD, K. Robert Shen, MD, Claude Deschamps, MD, and Dennis A. Wigle, MD, PhD
Division of General Thoracic Surgery, Mayo Clinic, Rochester, Minnesota

- 968 pT1 lesions resected at Mayo Clinic between 1998 and 2006
- 59 with pN2 disease (6.1%): 18 (31%) peripheral and 41 (69%) with centrally located cancers
- 36 had negative non-invasive mediastinal staging
- Most frequently affected lymph node station was 7 in 22 patients (37%), followed by 5,6 in 18 (31%)
- ½ of the time discovered at the time of mediastinal lymph node dissection

Mediastinal Staging
Difficult Anatomy is BETTER than Unfavorable Biology!!!
Don’t Forget About Physiology

- Pulmonary Function Tests
- Cardiopulmonary Exercise Test
- Lung Perfusion Scanning
- Cardiology Evaluation
Why Lobectomy for early stage cancers?

Randomized Trial of Lobectomy Versus Limited Resection for T1 N0 Non-Small Cell Lung Cancer

Lung Cancer Study Group (Prepared by Robert J. Ginsberg, MD, and Lawrence V. Rubinstein, PhD)
VATS Lobectomy
NEW STANDARD
Meta-analysis of intentional sublobar resections versus lobectomy for early stage non-small cell lung cancer

Christopher Cao¹, Sunil Gupta¹, David Chandrakumar¹, David H. Tian¹, Deborah Black¹, Tristan D. Yan¹

- 1078 sublobar vs 1667 lobectomy patients
Ongoing RCT

- CALGB 140503
- A phase III Randomized trial of lobectomy versus sublobar resection
- for small (≤2cm) peripheral non-small cell lung cancer
## Propensity Matched Results Sublobar vs SBRT

<table>
<thead>
<tr>
<th>Recurrence</th>
<th>Local Recurrence %</th>
<th>Regional Recurrence %</th>
<th>Distant Recurrence %</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>2.6</td>
<td>7</td>
<td>12.7</td>
<td>ASOCOG Z4032</td>
</tr>
<tr>
<td>SBRT</td>
<td>10.7</td>
<td>10</td>
<td>13.3</td>
<td>RTOG 0236</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Survival</th>
<th>OS % @ 3 yrs</th>
<th>DFS % @ 3 yrs</th>
<th>NPM OS % @3 yrs</th>
<th>NPM DFS % @3 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>68</td>
<td>92</td>
<td>78</td>
<td>72</td>
</tr>
<tr>
<td>SBRT</td>
<td>52</td>
<td>90</td>
<td>47</td>
<td>42</td>
</tr>
</tbody>
</table>

Crabtree et al, JTCVS, Volume 147, Number 4, 2014
Post Operative Recovery

• Beyond the hospitalization!!!

Return to Baseline Study (R-Base)

- Sixty-six patients comprised the study cohort and were grouped by average preoperative activity
- Minimally-invasive approach was associated with shorter inpatient stay: 4 days (IQR 2–5) vs. 5 (5–6), p=0.03 HOWEVER had no impact on return to baseline activity
<table>
<thead>
<tr>
<th></th>
<th>Low ( n = 21 )</th>
<th>Moderate ( n = 27 )</th>
<th>High ( n = 18 )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>71.6 ± 11.7</td>
<td>65.9 ± 8.6</td>
<td>59.9 ± 12.8</td>
<td>.01</td>
</tr>
<tr>
<td>Female, ( n )</td>
<td>11 (52.4)</td>
<td>12 (44.4)</td>
<td>9 (50.0)</td>
<td>.78</td>
</tr>
<tr>
<td>Charlson comorbidity index, score</td>
<td>1 (0 – 2)</td>
<td>2 (0 – 3)</td>
<td>1.5 (0 – 3)</td>
<td>.98</td>
</tr>
<tr>
<td>FEV1, L</td>
<td>2.4 ± 1.0</td>
<td>2.4 ± 0.6</td>
<td>2.9 ± 1.1</td>
<td>.17</td>
</tr>
<tr>
<td>FEV1, % predicted</td>
<td>90.2 ± 15.9</td>
<td>81.3 ± 18.1</td>
<td>88.7 ± 17.0</td>
<td>.17</td>
</tr>
<tr>
<td>DLCO, % predicted</td>
<td>63.4 ± 10.4</td>
<td>68.4 ± 14.5</td>
<td>72.7 ± 16.7</td>
<td>.12</td>
</tr>
<tr>
<td>Minimally-invasive approach, ( n )</td>
<td>19 (90.5)</td>
<td>22 (81.5)</td>
<td>15 (83.3)</td>
<td>.69</td>
</tr>
<tr>
<td>Sub-lobar, ( n )</td>
<td>8 (38.1)</td>
<td>6 (22.2)</td>
<td>7 (38.9)</td>
<td>0.36</td>
</tr>
<tr>
<td>Average Postoperative Inpatient Activity</td>
<td>898 ± 598</td>
<td>1620 ± 957</td>
<td>2231 ± 1400</td>
<td>.001</td>
</tr>
<tr>
<td>Average Postoperative Outpatient Activity</td>
<td>1815 ± 1427</td>
<td>3343 ± 1478</td>
<td>5350 ± 2449</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Maximum Postoperative Activity</td>
<td>3044 ± 2396</td>
<td>6414 ± 2894</td>
<td>8834 ± 3689</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Complications, ( n )</td>
<td>8 (38.1)</td>
<td>5 (18.5)</td>
<td>3 (16.7)</td>
<td>.22</td>
</tr>
<tr>
<td>Length of stay, days</td>
<td>4 (2 – 6)</td>
<td>4 (4 – 5)</td>
<td>4 (2 – 6)</td>
<td>.80</td>
</tr>
</tbody>
</table>
Functional recovery

Decreased Length of Stay Associated with Minimally-Invasive Pulmonary Resection Does Not Translate to Functional Recovery Advantage

Stephen J. Kaplan, MD, MPH
Examining Patient Burden and Drivers of Delayed Care in Patients Undergoing Surgical Treatment of Primary Lung Cancer

Caleb Barnhill MD, Charles Hillenbrand MD, Stephen J. Kaplan MD, MPH, Chelsea Jackson RN, Hong Jean ARNP, Madhan Kuppusamy MD, Michal Hubka MD
Thoracic Center at Virginia Mason Medical Center, Seattle, WA

Median travel burden (p<0.001)
urban = 100 miles [interquartile range, IQR 56-216.8]
rural = 385.7 [127.1-769]
regional = 780 [560-1936]

Median total healthcare encounters (p=0.03)
urban = 7 [6-9]
rural = 9 [7-9.5]
regional = 10 [7-12]

Delays in care
Physiologic work up
urban = 21%
rural = 152%
regional = 162%
Oncologic work up regional group only (49% increase)
It takes a village...from nodule to cancer

Chelsea Jackson, RN
Kristin Bohreer, RN

Lung Cancer
5-year Survival Rates

<table>
<thead>
<tr>
<th>Stage for stage comparison</th>
<th>Localized</th>
<th>Advanced</th>
<th>Metastatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>All stages of cancer</td>
<td>19.1%</td>
<td>28.2%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Stage for stage comparison</td>
<td>56.3%</td>
<td>46.2%</td>
<td>3.5%</td>
</tr>
</tbody>
</table>

Virginia Mason 5-year survival
National Cancer Institute Database (SEER)
Thank you!

- Access to expert opinion
- Appropriateness of care
- Decreasing patient burden
- Communication
- Remember: surgeons are people too