Robotic Surgery for Esophageal Cancer

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Esophageal Cancer on the Rise

*JNCI* 2005, 97:142  
*JNCI* 2008, 100:1184
INT 85-01: Surgery a “Big Biopsy”

- ’85-’90, Multi-Inst, T1-3N0-1, KPS ≥ 50%
- Randomized CRT vs RT
- Discoveries
  - CRT 25% survival
  - RT no survivors past 3 yrs (n=62)
  - 50.4 Gy best for CRT (RTOG 94-05 (INT 0123))
  - 68% able to complete CRT (10% severe toxic, 2% died)
  - Distant mets 1st site of recurrence 30%

Cooper et al. JAMA 281:1623, 1999
What does esophagectomy offer?

- Accurate assessment of the biology of the malignancy
- Chemotherapy does poorly for bulky disease
- Allows evaluation of response to therapy
- Identifies occult disease
- CT and PET are not sufficient to determine response to therapy
- Precise treatment to minimize toxicity and maximize QOL and Survival
Thoracotomy View: Limited Pleural Space Visibility

Increase Incision vs Limit Resection?
Minimally-Invasive Esophagectomy

- N=222 1996-2002
- 47 HGD & 175 Cancer
- Induction in 35%
- Conversion 7.2%
- ICU stay 1 day
- Hospital stay 7 days
- Operative mortality 1.4%
- Anastomotic Leak 11.7%
- ECOG 2202 Completed

Port Placement

1. Determine Location of Pathology
2. Determine Videoscope Placement
3. Triangle of Visibility
4. Robotic Arm Port Placement
5. Accessory Ports Placed
Robot Positioning
Esophagectomy Positioning: View and Arms
CO$_2$ Insufflation

- ↑ Exposure, distend mediastinum
- Pushes lung out of the way
- Reduces fogging of videoscope
- Assists in areolar
RATE (Robotic-Assisted Transhiatal Esophagectomy)

- Average Op Time 5°12’ (4-6°)
- EBL < 60 cc
- ICU 1-5 days
- Hospital Stay Average 8 days
- Problem-Robotic Arms unable to reach carina, blind dissection paratracheal esophagus from neck
RATE Example

- 64 yo LA Attorney
- Asymptomatic HG Dysplasia
- Prior Nissen through L Chest, Prior transverse colectomy, prior prostatectomy and prior gastrostomy
- D/C POD #5, Back to work 2 weeks.
Body Position to Gain Esophageal Exposure
Robotic Esophagectomy and LymphAdenectomy (3-Field), RELA

1. Right Chest

2. Supine Abdomen-Neck Dissection

3. Left Neck Anastomosis
2-Stage, 3-Field EsophagoLymphadenectomy

Robotic esophagectomy along with a composite 3-field lymphadenectomy.
Thoracic Phase: SetUp

- Body Position
- Port Placement (2x12-mm ports and 1x5-mm port, 3 x 8-mm ports)
- $\text{CO}_2$ 10 mmHg Insufflation
**Thoracic Phase: Initiation**

- Dissection of the Esophagus with all mediastinal tissue & TD
  - **Middle Thorax**
  - Hilar/Trachea
  - Hiatus
  - Thoracic Inlet/Cervical Esophagus
  - Thoracic Duct Ligation
- Drains (19 Fr lower and 15 Fr upper)
Thoracic Phase: Carina/Hila

- Dissection of the Esophagus with all mediastinal tissue & TD
  - Middle Thorax
  - Hilar/Trachea
  - Hiatus
  - Thoracic Inlet/Cervical Esophagus
  - Thoracic Duct Ligation

- Drains (19 Fr lower and 15 Fr upper)
Thoracic Phase: Thoracic Neck Dissection

- Dissection of the Esophagus with all mediastinal tissue & TD
  - Middle Thorax
  - Hilar/Trachea
  - Hiatus
  - Thoracic Inlet/Cervical Esophagus
  - Thoracic Duct Ligation

- Drains (19 Fr lower and 15 Fr upper)
Supine Abdominal Phase: Initiate Dissection

- Gastrohepatic dissection
- Short Gastrics
- Gastroepiploic dissection
- Hiatal dissection
- Pylorus dissection

Neck First
Supine Abdominal Phase
Gastric Tube

- Gastrohepatic dissection
- Short Gastrics
- Gastroepiploic dissection
- Hiatal dissection
- Pylorus dissection
- Tube creation
- Attach tube to specimen
Supine Abdominal Phase: Delivery Specimen

- Tube creation
- Attach tube to specimen
Neck Anastomosis

- Transect Mass with esophageal length
- Conduit hole for stapler
- Push conduit behind esophagus, into retrocervical area
- Linear 4.1 mm stapler, create 5 cm long anastomosis
- Replace NG tube through anastomosis
- Transverse stapler
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Case Completion
The End Result
Ivor-Lewis Technique

Robotic Ivor-Lewis: Chest
TransOral Anvil Unit
Ivor-Lewis Technique

### Table 141-5. Robotic Esophagectomy

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>n</th>
<th>OR Time (minutes)*</th>
<th>Estimated Blood Loss (mL)*</th>
<th>Length of Stay (days)*</th>
<th>Morbidity (%)</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodner</td>
<td>2005</td>
<td>6</td>
<td>173 (160-190)*</td>
<td>NR</td>
<td>14 (10-42)*</td>
<td>20</td>
<td>50% DFS 5 mos.</td>
</tr>
<tr>
<td>van Hillegersberg</td>
<td>2006</td>
<td>21</td>
<td>450 (370-550)*</td>
<td>400 (150-700)</td>
<td>18 (11-182)*</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>Kernstine(^{24, 64})</td>
<td>2007</td>
<td>14</td>
<td>666 (570-780)*</td>
<td>275 (50-950)</td>
<td>NR</td>
<td>29</td>
<td>17-mos. survival 87%</td>
</tr>
<tr>
<td>Galvani(^{20, 24, 64})</td>
<td>2008</td>
<td>18</td>
<td>267(^+)</td>
<td>54 (10-150)(^+)</td>
<td>10 (4-38)*</td>
<td>66</td>
<td>6% ana leaks, 1 thor duct inj, 1 voc cord par, 1 effusion, 2 atr fib</td>
</tr>
<tr>
<td>Kernstine(^+)</td>
<td>2008</td>
<td>39</td>
<td>544 (427-782)*</td>
<td>400 (25-1700)(^+)</td>
<td>10 (5-66)*</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

\(n = \) number of patients reported; NR = not reported.

*Median (range).

\(^+\)Mean (SD).

\(^+\)In press, includes 14 patients reported in 2007 publication.
COH Robotic Survival c/w Radiation Only vs ChemoRadiation (N=42)

- Overall Survival 1998 to Present
- Survival for:
  - Radiation Only (Blue)
  - ChemoRads (Red)
  - Robotic Surgery (Green)
- Median Survival
  - Rads only 4 mos
  - ChemoRads 12.5 mos
  - Robotic 37.5* mos
- Stage Adj p=0.0002

* MST not reached
Organizational Learning

Surgical Teams learn best when:

- Team chosen by Surgeon
- Cross department cooperation
- Early cases managed by Surgeon
- Outcomes studied

Hospital M: Longer Procedure Time than the rest of the Group

Hospital M better after 7
Harvard Business Review ‘02
Summary

- Technique Adaptable to Patient/Disease State
  - RATE
  - Robotic McKeown
  - Robotic Ivor-Lewis

- Adhere to Basic Principles

- Surgical team improves efficiency