SURGERY FOR TUMORS WITH Invasion of the Apex

...lung cancer of the apex of the chest involving any structure of the apical chest wall irrespective of symptoms...

...fewer than 5% of all bronchogenic carcinomas

Excluding: 2nd rib involvement and visceral pleura

Detterbeck, Ann Thorac Surg 2003

HISTORY

1. Before 1950 (1st era), superior sulcus tumors were thought to be incurable

2. Shaw and Paulson’s group (2nd era) → 30Gy in 10 fractions of radiotherapy followed by surgical resection, reporting a 30% 5-year survival

3. Late 1980s and 90s (3rd era) → development of new surgical techniques (Darteville et al) that enabled resection of tumors involving the spine and subclavian vessels

4. The most recent era (4th era) → large prospective multicenter phase-II trials (USA and Japan) → induction chemo-radiotherapy followed by resection, reporting around 50% 5-year survival

DIFFERENT TYPES and DIFFERENT APPROACHES

Posterior tumor  Mixed type  Anterior tumor

Posterior (Paulson) approach  Combined anterior and paulson approach  Anterior approaches:
- trans-clavicular
- trans-mammary
- trans-internal
- trans-scapular
- hemiclamshell
LITERATURE
the last 15 years

<table>
<thead>
<tr>
<th>Author</th>
<th>n*</th>
<th>Treatment</th>
<th>5y OS</th>
<th>Morbidity</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwong</td>
<td>44</td>
<td>CT/RT + surg</td>
<td>59%</td>
<td>45%</td>
<td>5%</td>
</tr>
<tr>
<td>Rusch*</td>
<td>110</td>
<td>CT/RT + surg + CT</td>
<td>44%</td>
<td>52.9%</td>
<td>4.5%</td>
</tr>
<tr>
<td>Fisher</td>
<td>44</td>
<td>CT/RT + surg</td>
<td>59%</td>
<td>n/a</td>
<td>4.5%</td>
</tr>
<tr>
<td>Kunito*</td>
<td>76</td>
<td>CT/RT + surg</td>
<td>56%</td>
<td>15% major</td>
<td>5%</td>
</tr>
<tr>
<td>Yldizeli</td>
<td>80</td>
<td>Surg + adj therapy</td>
<td>36.6%</td>
<td>n/a</td>
<td>0.8%</td>
</tr>
<tr>
<td>Bolton</td>
<td>36</td>
<td>CT/RT + surg</td>
<td>50%</td>
<td>27%</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

* Phase II trial

Induction CT/RT + Surgery
SWOG 9416 Rusch VW. J Clin Oncol 2007
JCO 9806 Kunito H. J Clin Oncol 2008

Surgery + Adjuvant therapy

INTERNATIONAL GUIDELINES

According to the results of SWOG 9416 and JCO 9806 trials induction chemo-radiotherapy followed by resection is adopted as the standard of care for Pancoast tumors in the clinical guidelines published by the ACCP [2007] and the NCCN [2012]

Induction CT/RT + Surgery

<table>
<thead>
<tr>
<th>SWOG-9416</th>
<th>JCO-9806</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of recruitment</td>
<td>1995-1999</td>
</tr>
<tr>
<td>N centers (pts/surgeon)</td>
<td>5 (76 surgeons)</td>
</tr>
<tr>
<td>Completed CT/RT</td>
<td>104 (95%)</td>
</tr>
<tr>
<td>Surgery</td>
<td>88 (80%)</td>
</tr>
<tr>
<td>Surgical mortality</td>
<td>3 (2.6%)</td>
</tr>
<tr>
<td>5 years OS</td>
<td>44%</td>
</tr>
<tr>
<td>Relapse rate</td>
<td>54.8%</td>
</tr>
</tbody>
</table>


...but

<table>
<thead>
<tr>
<th>SWOG-9416</th>
<th>JCO-9806</th>
</tr>
</thead>
<tbody>
<tr>
<td>N pts/surgeon</td>
<td>110/76</td>
</tr>
<tr>
<td>N pts/center</td>
<td>76/19</td>
</tr>
</tbody>
</table>
Long-Term survival affected by:
- Complete resection (p=0.01)
- Subclavian artery invasion (p=0.01)

Induction therapy should be considered for the patients with mediastinal lymph node involvement.

50 patients died of distant metastasis, mainly brain
CR 92% OS 5- and 10-years 36.6% and 25.9%

Surgical mortality: 0.8%

Our Philosophy
“The European Institute of Oncology Experience”

INDUCTION CHEMOTHERAPY + SURGERY

- Less toxicity compare to CT/RT → more pts to surgery
- Better local and distant control compare to surgery

“The European Institute of Oncology Experience”

In patients with Superior Sulcus Tumor, involving the subclavian artery or vertebral column, resection should be undertaken only in specialized center to achieve a complete resection.”


IEO EXPERIENCE: oncological indications

Surgery first
T3/4 N0
T3/4 N1 (minimal)

Induction chemotherapy
T3/4 N1 clavicular
T3/4 N2 minimal

Definitive CT/RT
T3/4 N2 (bulky) or N3
Surgical indications

Resectable and Operable Disease:
Patients (PS 0/1) with T3/4 N0/1

Absolute contraindications to Surgery
- Distant metastases
- N2/N3
- >50% vertebral body involvement
- Brachial plexus involvement above T1 nerve
- Invasion of esophagus/trachea

Our Background

“The European Institute of Oncology Experience”

Peedell, Clinical Oncology 2010
"...ANTERIOR LESIONS ARE BEST TREATED USING AN ANTERIOR APPROACH RATHER THAN THE CLASSIC SHAW-PAULSON POSTEROLATERAL APPROACH..."

"...FOR ANTERIOR SITUATED APICAL TUMORS, WHERE ADHERENCE TO THE SUBCLAVIAN VESSELS IS SUSPECTED, AN ANTERIOR APPROACH IS OFTEN PREFERRED..."


"...ONE OF THE PROBLEMS WITH THE TRANSCERVICAL APPROACH IS THE CLAVICULAR RESECTION..."

"...NOT SURPRISINGLY, POSTOPERATIVE ALTERATIONS IN SHOULDER MOBILITY AND CERVICAL POSTURE ARE TYPICAL..."

R.J. Ginsberg, Year Book of Thorac Cardiovasc Surg 1998
### Characteristics of the various anterior approaches

<table>
<thead>
<tr>
<th>Approach</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Trans-cervical | - Excellent exposure
- All type of lung resection feasible without accessory thoracotomy | - Resection of the clavicle
- Risk of scapula alata |
| Trans-manubrial| - Excellent exposure
- Leaves in situ the clavicle without muscular sacrifice | - Needs an accessory thoracotomy or resection of the first two ribs to perform the lung resection
- Difficult posterior dissection
- Risk of fall chest
- Very long ischemic incision
- Increased shoulder girdle dysfunction of impairment of pulmonary function |
| Hemiclamshell  | - Excellent exposure                                                        |                                                                               |
| Trans-scapular | - Adequate exposure                                                        |                                                                               |

### IEO EXPERIENCE: type of approach

- Transmanubrial + posterolateral thoracotomy (Paulson’s incision)
- Transmanubrial + anterolateral thoracotomy
- Transmanubrial alone
- Hemiclamshell

### Anterior Approach (TMA alone)

### Anterior + Midline Posterior Approach for Hemivertebrectomy
IEO experience from 1998 to 2013

Patients 94 (6pts/yr); 3 surgeons
Male 79 (84%)
Median age 62 yrs (44-80)

<table>
<thead>
<tr>
<th>Type of apical chest tumor</th>
<th>N=45 (47.9%)</th>
<th>N=39 (41.5%)</th>
<th>N=10 (10.6%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Posterior</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed type</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Induction treatments

- Yes n=48 (51%)
  - Chemotherapy n=38 (79,2%)
  - CT/RT n=9 (18,8%)
  - RT n=1 (2,1%)
### Adjuvant treatments

- Yes: n=33 (38.8%)
  - Chemotherapy: n=1 (1.3%)
  - CT/RT: n=3 (4%)
  - RT: n=29 (37.2%)
  - Not specified: n=5 (6.4%)

### RESECTIONS

**Right (n=48, 51.3%) vs Left (n=46, 48.7%)**

<table>
<thead>
<tr>
<th>Lung</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobectomy</td>
<td>78 (83%)</td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Sleeve lobectomy</td>
<td>6 (6.5%)</td>
</tr>
<tr>
<td>Wedge</td>
<td>7 (7.5%)</td>
</tr>
</tbody>
</table>

Complete resection 90.4%

### POSTOPERATIVE OUTCOME

- 30 and 90-day MORTALITY → 5.3% (5/94) and 9.6% (9/94)
  - Anterior: 6.4% (6/94)
  - Posterior: 1.1% (1/94)
  - Combined anterior and posterior: 2.1% (2/94)

### POSTOPERATIVE COMPLICATIONS

16% (15/94) (MAJOR)

- ICU stay (median): 1 days (0-160)
- Hospital Stay (median): 9 days (5-116)

### OVERALL SURVIVAL

Follow-up 36 months (median/range 6-146)
**N STATUS**

<table>
<thead>
<tr>
<th>Status</th>
<th>1-year</th>
<th>2-year</th>
<th>5-year</th>
<th>10-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>pN+</td>
<td>52 (35-69)</td>
<td>22 (7-36)</td>
<td>18 (5-31)</td>
<td>-</td>
</tr>
<tr>
<td>pNx</td>
<td>50 (1-99)</td>
<td>25 (0-67)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>pN0</td>
<td>84 (74-93)</td>
<td>70 (58-83)</td>
<td>48 (33-62)</td>
<td>35 (18-53)</td>
</tr>
<tr>
<td>pN</td>
<td>84 (74-93)</td>
<td>70 (58-83)</td>
<td>48 (33-62)</td>
<td>35 (18-53)</td>
</tr>
</tbody>
</table>

**p STAGE**

<table>
<thead>
<tr>
<th>Stage</th>
<th>1-year</th>
<th>2-year</th>
<th>5-year</th>
<th>10-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>60 (46-74)</td>
<td>37 (23-51)</td>
<td>26 (12-40)</td>
<td>22 (9-36)</td>
</tr>
<tr>
<td>Stage I-II</td>
<td>85 (75-95)</td>
<td>66 (52-79)</td>
<td>49 (34-64)</td>
<td>31 (14-48)</td>
</tr>
<tr>
<td>Stage III</td>
<td>51 (36-67)</td>
<td>27 (13-41)</td>
<td>17 (4-30)</td>
<td>-</td>
</tr>
</tbody>
</table>

**Type of Pancoast**

<table>
<thead>
<tr>
<th>Type</th>
<th>1-year</th>
<th>2-year</th>
<th>5-year</th>
<th>10-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>60 (46-74)</td>
<td>37 (23-51)</td>
<td>26 (12-40)</td>
<td>22 (9-36)</td>
</tr>
<tr>
<td>Posterior</td>
<td>83 (79-86)</td>
<td>64 (48-81)</td>
<td>50 (32-68)</td>
<td>36 (15-58)</td>
</tr>
<tr>
<td>Both</td>
<td>77 (54-100)</td>
<td>62 (35-88)</td>
<td>28 (1-54)</td>
<td>14 (0-37)</td>
</tr>
</tbody>
</table>

**Induction Treatments**

- Log-rank P=0.16
- CT only vs None P=0.11

- Not significant…
- …but patients underwent induction CT had higher stage

**Conclusions**

- N status significantly influence survival results
- Best candidate T3N0 (5-yr 50%, 10-yr 35%)
- Induction treatment should be indicated on case-by-case basis according to the T extension and N status
- High percentage of radical resection (97%) and the prevalence of systemic recurrence may hypothesizes a role to the adjuvant chemotherapy
Thank you!