Surgical Approaches to Pulmonary Metastases

Raja M Flores MD
Professor and Chief
Thoracic Surgery
Mount Sinai School of Medicine
New York, New York
History of Lung Metastasectomy

- 1882 Weinlechner
- 1926 Divis
- 1933 Barney & Churchill
- 1940 Alexander & Haight
- 1979 McCormack et al
- 1997 Pastorino
Pulmonary Metastasectomy

The Problem

Marcove RC, Mike V, Hajek JV et al.
Osteogenic sarcoma under the age of 21: a review of 145 operative cases after amputation

- 83% developed pulmonary metastases within two years and **ALL DEAD** within next two years
Pulmonary Metastasectomy
The Solution

Martini N, Huvos AG, Mike V. et al.
Multiple pulmonary resections in the treatment of osteogenic sarcoma.

29 consecutive patients underwent thoracotomy
22 completely resected and re-resected
32% five year survival
18% twenty year survival
The role of metastectomy is dependent on the biology of the tumor.
Pulmonary Metastasectomy
Modern Evolution

- Newer chemotherapeutic agents
- Effective on micrometastatic disease
- Unable to eradicate gross disease
- Adjuvant or salvage surgery

- Also when chemotherapy is completely ineffective
## Pulmonary Metastasis

### Survival after Resection

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th># Patients</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain</td>
<td>1984</td>
<td>443</td>
<td>35</td>
</tr>
<tr>
<td>Eckersberger</td>
<td>1988</td>
<td>122</td>
<td>38 / 28</td>
</tr>
<tr>
<td>Venn</td>
<td>1989</td>
<td>118</td>
<td>35 / 51</td>
</tr>
<tr>
<td>Forquier</td>
<td>1997</td>
<td>50</td>
<td>44*</td>
</tr>
<tr>
<td>Robert</td>
<td>1999</td>
<td>276</td>
<td>48</td>
</tr>
<tr>
<td>Pastorino</td>
<td>1997</td>
<td>5206</td>
<td>36</td>
</tr>
<tr>
<td>Piltz</td>
<td>2002</td>
<td>105</td>
<td>40*</td>
</tr>
</tbody>
</table>
Criteria for Resection

1. Presence of lung nodules or changes consistent with metastases
2. Primary tumor controlled
3. Complete resection probable
4. Sufficient lung reserve after resection
5. No extrathoracic metastases
6. Alternative treatment not effective
# Rationale for metastectomy in various primary tumors

<table>
<thead>
<tr>
<th>Primary Site</th>
<th>Goal</th>
<th>When to resect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarcoma</td>
<td>Permanent cure</td>
<td>When possible</td>
</tr>
<tr>
<td>Germ cell</td>
<td>Teratoma</td>
<td>Systematic</td>
</tr>
<tr>
<td>Colon</td>
<td>Cure ± Liver</td>
<td>Selective</td>
</tr>
<tr>
<td>Kidney</td>
<td>Occasional cure</td>
<td>Highly selective</td>
</tr>
<tr>
<td>Melanoma</td>
<td>New primary, cure</td>
<td>Single lesion</td>
</tr>
<tr>
<td>Breast</td>
<td>New primary, ER/PR</td>
<td>Single lesion</td>
</tr>
</tbody>
</table>
Any solitary metastasis must consider the possibility of a new primary lung cancer.
Resection versus Site of Metastasis

1. Lobectomy
2. Pneumonectomy
3. Wedge Resection
4. Deep Wedge
VATS Wedge resection

A non-anatomic resection of lung parenchyma
Wedge
Disadvantage

• The lung is a 3-dimensional structure
• A wedge converts it into a 2-dimensional structure
• Therefore, greater loss of normal lung parenchyma
Precision Cautery
Pulmonary Metastasectomy

Results of Metastasectomy

Pastorino et al.

Long-term results of lung metastasectomy: Prognostic analyses based on 5206 cases. The International Registry of Lung Metastases.

J Thorac Cardiovasc Surg 1997;113:37-49
### Long term survival by tumor

<table>
<thead>
<tr>
<th>Primary</th>
<th>#</th>
<th>5-year %</th>
<th>10 year %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorectal</td>
<td>653</td>
<td>35%</td>
<td>22%</td>
</tr>
<tr>
<td>Breast</td>
<td>411</td>
<td>37%</td>
<td>21%</td>
</tr>
<tr>
<td>Kidney</td>
<td>402</td>
<td>41%</td>
<td>24%</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>1917</td>
<td>31%</td>
<td>26%</td>
</tr>
<tr>
<td>Melanoma</td>
<td>282</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>Germ cell</td>
<td>318</td>
<td>68%</td>
<td>63%</td>
</tr>
<tr>
<td>TYPE OF RESECTION</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedge resection</td>
<td>67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmentectomy</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lobectomy/ Bilobectomy</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The International Registry of Lung Metastasis

<table>
<thead>
<tr>
<th>PROCEDURE</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral Thoracotomy</td>
<td>58</td>
</tr>
<tr>
<td>Bilateral Thoracotomy</td>
<td>11</td>
</tr>
<tr>
<td>Sternotomy</td>
<td>27</td>
</tr>
<tr>
<td>Thoracoscopy</td>
<td>2</td>
</tr>
</tbody>
</table>
The International Registry of Lung Metastasis
Prognostic Grouping

<table>
<thead>
<tr>
<th>Group</th>
<th>Resectable</th>
<th>Risk Factor</th>
<th>DFI</th>
<th># Mets.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Yes</td>
<td>None</td>
<td>&gt;36 mo.</td>
<td>Single</td>
</tr>
<tr>
<td>II</td>
<td>Yes</td>
<td>One</td>
<td>&lt;36 mo.</td>
<td>Or Multiple</td>
</tr>
<tr>
<td>III</td>
<td>Yes</td>
<td>Two</td>
<td>&lt;36 mo.</td>
<td>&amp; Multiple</td>
</tr>
<tr>
<td>IV</td>
<td>Unresectable</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We know the numerator but NOT the denominator
The International Registry of Lung Metastasis

Overall Actuarial Survival
Complete vs Incomplete Resection
The International Registry of Lung Metastasis

Survival according to Number of Metastasis
The International Registry of Lung Metastasis

Survival according to Histology
The International Registry of Lung Metastasis

Survival According to Disease Free Interval
The International Registry of Lung Metastasis

Survival based on Prognostic Groups
Oligometastasis : Colorectal
Pulmonary Metastasis from Colorectal Cancer

Overall Survival

N = 167
5 yr. survival = 32.4%
Med. Survival 40.2 mo

Pfannschmidt J. et al J Th CV Surg 2003;126:732-739
Pulmonary Metastasis from Colorectal Cancer

Survival based on # of Metastasis

Pfannschmidt J. et al J Th CV Surg 2003;126:732-739
Pulmonary Metastasis from Colorectal Cancer

Survival based on Lymph Node Status and Pre-operativ CEA level

Pfannschmidt J. et al J Th CV Surg 2003;126:732-739
Pulmonary Metastasectomy

Resection of lung/liver metastases

- 81 patients
- Median follow-up of 3.7 years
- 43% DOD
- 26% AWD
- 31% NED

* 30% actual 5-year survivors
Metastatic Melanoma to Lung

Survival after Surgical vs. Non-surgical Treatment

23% of patients in the MSKCC prospective database from 1983-1997 developed or presented with pulmonary metastases.

Pulmonary Metastases

Soft Tissue Sarcoma


3149 adult patients with soft tissue sarcoma.

719 patients with lung metastasis.

248 patients underwent pulmonary resection.

86 patients underwent pulmonary re-resection.
Pulmonary Metastasis

Soft Tissue Sarcomas

Disease-specific Survival

Overall  By Treatment
Survival following re-resection

- n=86
- median survival: 43 mo
- 5 year survival: 36%
- median follow-up: 35 months
Conclusions

• Metastectomy can be performed on all tumors with favorable biology

• Selected patients
  • Disease free interval
  • Complete resection
  • Good pulmonary function
  • Number of lesions

• Indications evolving as chemotherapy evolves

• NOT FOR ALL PATIENTS