SURGERY OF SARCOMA
LUNG METASTASES

Scott Schuetze, MD, PhD
Professor of Internal Medicine
University of Michigan
DISCLOSURES

• Nothing to disclose relevant to this presentation
The majority of primary soft tissue and bone sarcoma can be cured by surgery +/- radiation.

About 30-50% of patients diagnosed with intermediate to high grade sarcoma develop metastatic disease.

Lung is the most common site of metastasis.

Metastases are rarely eradicated by chemotherapy.

If surgery can cure primary sarcoma, can it cure metastatic sarcoma?
LIMITED DATA FOR RECOMMENDATIONS

- Lack of prospective randomized trials
- Patient selection bias for thoracic surgery referral
- Outcome affected by disease heterogeneity
- Outcome bias regarding surgical expertise
- Outcome regarding surgical approach (open versus videoscopic)
- Limited long-term follow-up data is available
- Development of new technology (stereotactic radiation)
- Improvement in imaging resolution over past 20 years - impact on referral and outcome
GOALS OF LUNG METASTASECTOMY

• Establish diagnosis
• Palliate symptoms
• Prolong survival
• Cure sarcoma
DIAGNOSIS: LUNG NODULES IN SARCOMA

40 yo PEComa

50 yo UPS

35 yo LMS

65 yo liposarcoma
ARE NOT ALWAYS SARCOMA

40 yo PEComa
Bronchogenic carcinoma

50 yo UPS
Histoplasma

35 yo LMS
LMS

65 yo liposarcoma
MALT
METASTASECTOMY IN SARCOMA

- Osteosarcoma
- Soft tissue sarcoma
- Ewing sarcoma (very little data)
METASTASECTOMY IN OSTEOSARCOMA

- 17 yo woman presented November 2007 with mass in proximal humerus
- Core biopsy demonstrated high-grade chondroblastic osteosarcoma
- 2 cycles MAP in EURAMOS-1
- Proximal humerus resection February 2008
  - 9 cm mixed osteoblastic/chondroblastic OS
  - 75-80% necrosis
- Randomized to 4 cycles MAP
IMAGING 38 MONTHS AFTER DIAGNOSIS
SURGERY RECOMMENDED

- February 2011 right upper lobectomy and left lower wedge resection
- 3.4 cm and 0.4 cm osteoblastic osteosarcoma, clear resection margins
- 5 cycles ifosfamide
- January 2016, no evidence of disease
LUNG METASTASECTOMY IN OSTEOSARCOMA

- PTS ≤55 yrs HG osteosarcoma extremity metastatic to lung 1985 – 2005 (Instituto Ortopedico Rizzoli)
  - 323 PTS (27%) of 1197 PTS treated
  - 235 later lung mets (73%)
  - 88 lung mets at presentation
- PTS HG osteosarcoma extremity or trunk who developed recurrence 1979 – 1998 (Cooperative Osteosarcoma Study Group)
  - 576 PTS (34%) with recurrence of 1702 PTS enrolled
  - 373 (22%) with lung only metastases
- PTS ≤40 yrs HG localized osteosarcoma extremity 1983 – 2002 (European Osteosarcoma Intergroup)
  - 564 PTS (53%) with recurrence of 1067 enrolled
  - 307 (29%) with lung only metastases

A Briccoli et al. 2010 Surgical Oncology 19:193-199
B Kempf-Bielack et al. 2006 JCO 23:559-568
H Gelderblom et al. 2011 EJC 47:895-902
LONG-TERM SURVIVAL ACHIEVABLE

B Kempf-Bielack et al. 2006 JCO 23:559-568

H Gelderblom et al. 2011 EJC 47:895-902

A Briccoli et al. 2010 Surg Onc 19:193-199

Fig 2. Estimates of postrelapse overall survival in relation to surgical remission status. Log-rank $P < .0001$. 2nd CR, second complete remission.
PATIENT SELECTION FOR SURGERY

• Prognostic variables
  • Ability to obtain complete resection
  • Number of metastases (fewer is better)
  • Number of surgeries (fewer is better)
  • Time from diagnosis to lung metastases (longer is better)
• Impact uncertain
  • Surgical modality – open thoracotomy vs videoscopic
  • Addition of chemotherapy
48 yo man presented April 2012 with 6 cm mass in left thigh

Core needle biopsy demonstrated grade 3 Undifferentiated Pleomorphic Sarcoma (UPS)

Stage 3

Pre-operative doxorubicin and ifosfamide

R0 resection, 90% necrosis

Post-operative radiation
SURGERY RECOMMENDED

- November 2013 left lower lobe wedge resection
- 1.5 cm UPS, resection margin clear of sarcoma
- December 2015, no evidence of sarcoma
LUNG METASTASECTOMY IN SOFT TISSUE SARCOMA

- MDA series 15,744 patients seen 1998-2006 (all sarcoma)
  - 4,355 (28%) with lung metastases
    - 234 (5.6%) had lung metastasectomy
    - 147 had single operation
      - 22% osteosarcoma, 16% MFH, 15% SS, 12% leiomyosarcoma, 35% other
- Mayo Clinic series 1216 patients seen 1976-1991 (extremity/trunk STS)
  - 274 (23%) with lung metastases
    - 214 had lung metastasectomy
      - 40% MFH, 29% SS, 13% liposarcoma, 10% fibrosarcoma, 6% leiomyosarcoma
- MSKCC series 3149 patients seen 1982-1997 (STS sarcoma)
  - 719 (23%) with lung metastases
    - 213 had lung metastasectomy

KG Billingsley et al. 1999 Ann Surg 229:602
SURVIVAL AFTER LUNG METASTASECTOMY

KG Billingsley et al. 1999 Ann Surg 229:602

## 5-YR SURVIVAL - THAMES CANCER REGISTRY

<table>
<thead>
<tr>
<th>Author (published)</th>
<th># of patients</th>
<th>5-yr survival</th>
<th>Median date of series</th>
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<tr>
<td>Gadd 1993</td>
<td>78</td>
<td>18%</td>
<td>1987</td>
</tr>
<tr>
<td>Smith 2009</td>
<td>94</td>
<td>18%</td>
<td>1989</td>
</tr>
<tr>
<td>Rehders 2007</td>
<td>61</td>
<td>25%</td>
<td>1997</td>
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<tr>
<td>Sardenberg 2010</td>
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<td>35%</td>
<td>1999</td>
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<tr>
<td>Chen 2009</td>
<td>23</td>
<td>44%</td>
<td>1999</td>
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<tr>
<td>Garcia Franco 2009</td>
<td>22</td>
<td>23%</td>
<td>2002</td>
</tr>
<tr>
<td>Metastasectomy pts</td>
<td>355</td>
<td>25%</td>
<td></td>
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<tr>
<td>TCR (total stage IV)</td>
<td>5615</td>
<td>13%</td>
<td>1985-1994</td>
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<tr>
<td>TCR (total stage IV)</td>
<td>6256</td>
<td>15%</td>
<td>1995-2004</td>
</tr>
</tbody>
</table>

WHEN TO CONSIDER SURGERY FOR SARCOMA LUNG METASTASES

- Primary sarcoma definitively treated
- Limited metastatic disease that can be removed by surgery
- Medically fit with adequate pulmonary reserve
- Patient survival best when:
  - Disease-Free Interval between diagnosis of primary and metastasis >12 months
  - Fewer than 4 metastases
  - Complete resection of metastases
CONCLUSIONS

• Lung metastasectomy in selected patients can be curative
• Impact in osteosarcoma likely greater than soft tissue sarcoma
• Thoughtful patient selection and cooperation from thoracic oncology are needed