Reirradiation of Thoracic Cancers with Intensity Modulated Proton Therapy

J. C. Ho\textsuperscript{1}, Q. N. Nguyen\textsuperscript{1}, H. Li\textsuperscript{2}, P. K. Allen\textsuperscript{1}, X. Zhang\textsuperscript{2}, X. R. Zhu\textsuperscript{2}, D. R. Gomez\textsuperscript{1}, S. H. Lin\textsuperscript{1}, M. T. Gillin\textsuperscript{2}, R. U. Komaki\textsuperscript{1}, Z. Liao\textsuperscript{1}, S. M. Hahn\textsuperscript{1}, and J. Y. Chang\textsuperscript{1}

\textsuperscript{1}Department of Radiation Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX, \textsuperscript{2}Department of Radiation Physics, The University of Texas MD Anderson Cancer Center, Houston, TX
Background

- Challenges in treating recurrent lung cancer
  - Many patients are not candidates for surgery
  - Reirradiation: concerns about cumulative radiation doses to critical organs limit use of higher radiation dose
    - Older techniques resulted in up to 30% serious toxicity

⇒ Patients generally offered only palliative, lower doses of reirradiation
Background

- Proton radiation decreases radiation dose and toxicity to normal tissue, compared to traditional photon radiation.
- 2 types of proton radiation: passive (older) and intensity modulated proton therapy, IMPT (newer).
- IMPT can precisely target the tumor and spare nearby normal tissue, to safely deliver a higher, curative radiation dose.
Method

• Retrospective review of 27 patients treated at MD Anderson Cancer Center from 2011 - 2016

• IMPT for reirradiation of thoracic malignancies, with definitive intent
  • 81% had non-small cell lung cancer
  • 81% had centrally located tumors
  • Median 29.5 months from initial radiation to reirradiation

• Median reirradiation dose 66 Gy

• Median follow-up all patients 11.2 months (25.9 months for patients still alive)
Results

Overall Survival

- Median 18 m
- 1-year OS 54%

Progression Free Survival

- Median 19.3 m
- 1-year PFS 51%

Freedom from Local Failure

- Median NR
- 1-year 78%

Freedom from Locoregional Recurrence

- Median NR
- 1-year 61%
Impact of Reirradiation Dose

<table>
<thead>
<tr>
<th></th>
<th>Higher Dose ≥ 66 Gy</th>
<th>Lower Dose &lt; 66 Gy</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1yr freedom from LF</td>
<td>100%</td>
<td>49%</td>
<td>0.013</td>
</tr>
<tr>
<td>Median freedom from LF</td>
<td>NR</td>
<td>9.1 m</td>
<td></td>
</tr>
<tr>
<td>1yr freedom from LRR</td>
<td>84%</td>
<td>23%</td>
<td>0.035</td>
</tr>
<tr>
<td>Median freedom from LRR</td>
<td>NR</td>
<td>6.8 m</td>
<td></td>
</tr>
<tr>
<td>1yr PFS</td>
<td>76%</td>
<td>14%</td>
<td>0.050</td>
</tr>
<tr>
<td>Median PFS</td>
<td>NR</td>
<td>6.8 m</td>
<td></td>
</tr>
<tr>
<td>1yr OS</td>
<td>62%</td>
<td>46%</td>
<td>0.289</td>
</tr>
<tr>
<td>Median OS</td>
<td>18.5</td>
<td>10.6</td>
<td></td>
</tr>
</tbody>
</table>

Toxicity

<table>
<thead>
<tr>
<th>Type</th>
<th>Grade 1-2</th>
<th>Grade 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary</td>
<td>19 (70%)</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>Esophagitis</td>
<td>15 (56%)</td>
<td>0</td>
</tr>
<tr>
<td>Dermatitis</td>
<td>10 (37%)</td>
<td>0</td>
</tr>
<tr>
<td>Fatigue</td>
<td>23 (85%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Pain</td>
<td>10 (37%)</td>
<td>0</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>3 (11%)</td>
<td>0</td>
</tr>
</tbody>
</table>

- Minimal serious toxicity
- No grade 4 or 5 toxicities
Conclusions

• First report on IMPT for reirradiation of lung cancer
  • Outcomes improved compared to other reirradiation studies
  • Well tolerated, with minimal serious toxicity (7% vs. up to 30% in other studies)
  • Better local control (15% vs 35-40% failure) and survival (median 18 vs. 11-14 months)
  • Higher reirradiation doses ($\geq 66$ Gy) associated with improved outcomes

• IMPT appears to be the optimal choice for reirradiation:
  • To spare critical structures from the toxicity of cumulative radiation
  • To deliver curative reirradiation doses for challenging, central tumors