Stereotactic body radiotherapy for lung metastases: retrospective analysis of a single-center

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Introduction and Objective

A significant number of cancer patients with initially localized disease develop distant metastases at follow up. A subset of patients with successful treatment of the primary tumor develop oligometastatic disease months to years after initial treatment. Other patients with metastatic disease present with long-lasting stable disease or remission during systemic treatment and develop progression in single lesions in later course of disease. For these patients with low tumor burden, a semi-curative treatment might be an option. In recent years, stereotactic body radiotherapy (SBRT) of the lung has been shown to provide an alternative to surgical resection of lung metastases. Typically, SBRT in the lung is performed with high single-doses per fraction. High radiation doses to the lung could result in severe fibrosis, which might especially be relevant for patients with impaired lung function.

Methods

We retrospectively analyzed 95 metastatic patients (male, n=64; female, n=31) who underwent SBRT in the lung at our institution from 2005-2015 with a total of 166 lung metastases. The median age was 68 years (range: 38-98 years) at initial SBRT treatment. Primary tumors were colorectal cancer (n=35), renal cell carcinoma (n=15), head and neck cancer (n=12), melanoma (n=8), and other malignancies (n=25). Parameters assessed were: local control, survival, lung function test before start of treatment and during follow up, PTV volume, extent of fibrosis on CT scans.

Table 1: Patients’ Characteristics

<table>
<thead>
<tr>
<th>Patients’ Characteristics</th>
<th>Total No. of patients (f/m)</th>
<th>Median age (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Tumor</td>
<td></td>
<td></td>
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<tr>
<td>Colorectal Cancer</td>
<td>35</td>
<td>37 %</td>
</tr>
<tr>
<td>Renal Cell Carcinoma</td>
<td>15</td>
<td>16 %</td>
</tr>
<tr>
<td>Head and Neck Cancer</td>
<td>12</td>
<td>13 %</td>
</tr>
<tr>
<td>Melanoma</td>
<td>8</td>
<td>8 %</td>
</tr>
<tr>
<td>Other Malignancies</td>
<td>25</td>
<td>26 %</td>
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</tbody>
</table>

Results

The treatment regimen most often used was 12.5 Gy x 3 fractions prescribed to the 65% isodose (n=100; EQD2 for α/β=10 Gy: 70.3 Gy at prescribed isodose, 140.5 Gy at 100% isodose) and 15 Gy x 3 fractions prescribed to the 65% isodose (n=33; EQD2 for α/β=10 Gy: 91.9 Gy at prescribed isodose, 183.8 Gy at 100% isodose). The median PTV volume was 15.9 cm³ (range: 3.6 – 404.5 cm³). Median follow up was 20 months (range 1 – 136 months).

The overall survival at 1 and 2 years was 85% and 64%, respectively. We achieved high local control after SBRT treatment at 1 and 2 years which was 93% and 80%, respectively. Signs of morphologically dense radiation induced fibrotic changes (hounsfield units > 10 as evaluated on CT scans) 4-6 months after treatment was seen in 40 % of all treated lesions. The median diameter of these fibrotic changes were 6.0 cm (range: 2.0 – 10.4 cm). Before SBRT treatment the median baseline FEV1 value of lung function test was 2.5 L (range: 0.96 – 3.96 L). FEV1 values at 1 years after treatment (expressed as mean percentage of baseline FEV1 ±SD) decreased to 95% (±18%) which was significant (p<0.05) in a paired t-test.

Conclusion

SBRT treatment for lung metastases results in high local control rates and can be safely applied. The impact on lung function test at one year after treatment was minimal although high biological doses were delivered. We conclude, that SBRT to the lung can be recommended to oligometastatic patients as an effective alternative treatment to surgical resection.

References


Figure 1: Local Control Kaplan Meier plot of local control of all lung metastases (n=133 with at least one follow up scan) treated with SBRT.

Figure 2: Example of initial CT and follow-up scans after SBRT (A) Planning CT for treatment of a metastasis in right lower lobe. (B) Slight shrinkage at 6 weeks after SBRT (C) M. 8 months after SBRT the treated lesion is no longer visible and fibrotic changes appear. At two years (D) and three years (E) after treatment dense fibrotic reactions are visible.

Figure 3: Lung function test Absolute FEV1 values are shown before start of treatment and at 10-14 months after SBRT in 20 patients.