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Stereotactic Body Radiotherapy (SBRT) for Multiple (≥3) Synchronous/Metachronous Lung Metastasis

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Abstract
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Abstract

Objectives:

Treatment of oligometastatic disease with SBRT have shown an increase in survival, leading to an increase in simultaneous or repeat SBRT indications. Constraints used to evaluate single lesion SBRT might not be sufficient to estimate toxicity risk after multiple SBRT in the lungs. Thus, in this study we aimed to determine risk factors (dosimetric and lesion characteristics) in patients treated with SBRT for 3 or more lung lesions.

Methods:

Patients treated for 3 and more lung lesions (simultaneously or at different courses) using SBRT between 2013 – 2022 with a follow up of at least 6 months were included in this study. Overall-survival (OS), local control (LC) and radiation pneumonitis-free survival (RPFS) were calculated. Dosimetric parameters (Lung EQD2 for alpha/beta=3, V20, V5, mean lung dose (MLD)) and lesions characteristics (total PTV volume, PTV to total lung volume ratio) were evaluated in terms of correlation with radiation pneumonitis (RP) and outcome.

Results:

A total of 89 lesions in 16 patients (colorectal:7; lung:4; soft tissue sarcoma:2; gastric cancer:1; ovarian cancer:1; cholangiocellular carcinoma:1) were treated, with a median of 4 lesions (range 3-13 lesions) per patient. Median SBRT dose was 45 Gy (range 21-60 Gy) given in median 5 fractions (range 1-10 fractions). Median treatment interval between lung SBRT was 10 months (0-67 months). Median follow-up time from the first SBRT was 44 months (range 8-94 months). Median OS from the first SBRT was 56 months. OS was found to be associated with the number of SBRT lesions treated (median 94 months for =3 lesions, median OS 17 months for ⩾4 lesions, p=0.013). Complete response was achieved in 58 (65.2%), partial in 26 (29.2%) and progression in 5 (5.6%) lesions. Four of the five progressed lesions were treated with low total doses (BED10 = 35.7 Gy). RP (1 grade 1, 2 grade 3 and 1 grade 5) was observed in 4 (25%) patients after 3, 5, 9 and 13 courses of SBRT. Median RPFS (3 years RPFS: 64.6%) was not reached. RPFS was lower in patients with total PTV volume ⩾84 cc (median was not reached for PTV volume < 84 cc, 6 months for PTV volume ⩾84 cc; p=0.01) and in patients with total PTV to total lung volume ratio higher than 0.014 (Median was not reached for PTV/lung volume < 0.014, 6 months for >0.014; p=0.007). RPFS did not show any correlation with any of the other tumor and dosimetric parameters. Heart failure or pulmonary embolism was observed in two patients and total PTV volumes were larger than 160 cc in both.

Conclusion(s):

Pneumonitis and other serious toxicities were observed in patients treated with large total PTV volume and high PTV/total lung volume ratio. Treatment of multiple/repeat lung metastasis with SBRT is a feasible and safe method with moderate toxicity.