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Abstract

Robotic Radiotherapy for Single and Multiple Cerebral Metastases from Melanoma, Renal, Lung and Breast Cancer

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Abstract

Objectives: The aim of the study was to evaluate the efficiency, safety and prognostic factors of the robotic stereotactic radiosurgery (SRS) and hypofractionated stereotactic radiotherapy (SRT) in the treatment of single and multiple brain metastases.

Methods: This is a retrospective study of 111 patients with 221 brain metastases (range 1 – 9 lesions in each patient) treated using robotic radiotherapy system due to melanoma, lung, breast or kidney cancer brain metastases between 2011 and 2015. All patients were in good clinical status (mean and median Karnofsky Performance Status score – 80). In 53 patients primary location of the tumor was lung, in 37 – breast, in 12 – kidney and 9 patients were diagnosed with melanoma. The time between the diagnosis of the primary tumor and brain metastases ranged from 0 to 251 months (mean 40 months, median 25 months). In 12 patients brain metastases were found prior to the diagnosis of the primary tumor.

Results: The planned dose was delivered in 1 – 4 fractions. 48.9% of the lesions were treated with single fraction (median dose 18.0 Gy), 51.1% using fractionated regimens (median dose 19.0 Gy). The mean total tumor volume (TTV) was 11.0 mL (range 0.06 to 63.96 mL). Radiological evaluation of the treatment effects was performed in 52 patients (47.7%). The survival probability was calculated with the use of the Kaplan – Meier estimator. The median overall survival (OS) in the whole group was 10.8 months. Longer OS was observed in patients with single brain metastases – median 22.5 months – in comparison to those with multiple lesions – median 8.1 months ($p = 0.0001$). Patients with controlled systemic disease lived longer – median 18.3 months – compared to progressive systemic disease – median 6.1 months ($p = 0.003$). Patients with higher KPS score lived significantly longer ($p = 0.03$). Additional whole brain radiotherapy had no impact on the OS. SRS and SRT resulted in similar overall survival. High TTV (> 6 ml) was associated with shorter OS ($p = 0.02$). During radiological follow-up, progression of the treated lesion was observed in 22 patients (44.2%) 2 – 49 months after SRS or SRT. Median local progression-free survival was 16.0 months. In multivariate analysis four factors were found to be statistically significant predictors of OS: lower KPS score ($p = 0.003$), presence of uncontrolled systemic disease ($p = 0008$), multiple brain metastases ($p = 0.02$) and higher TTV ($p = 0.04$).

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Conclusions: Stereotactic radiosurgery and hypofractionated stereotactic radiotherapy have similar effectiveness in the treatment of brain metastases. Multiple brain metastases, lower KPS score, high TTV and uncontrolled systemic disease are significant risk factors that affect overall survival.