Microbeam radiation therapy (MRT), a novel form of spatially fractionated radiotherapy (RT).

MRT has been identified as a promising treatment concept that might be applied to patients with malignant central nervous system.

Microbeam radiation therapy (MRT) using synchrotron-generated X-ray beams allows for extremely high-dose irradiation. However, the toxicity of MRT in central nervous system (CNS) use is still unknown. To gather baseline toxicological data, Mukumoto et al evaluated mortality in normal mice following CNS-targeted MRT. Male C57BL/6 J mice were head-fixed in a stereotaxic frame. Synchrotron X-ray-beam radiation was provided by the SPring-8 BL28B2 beam-line. For MRT, radiation was delivered to groups of mice in a 10 × 12 mm unidirectional array consisting of 25-µm-wide beams spaced 100, 200 or 300 µm apart; another group of mice received the equivalent broad-beam radiation therapy (BRT) for comparison. Peak and valley dose rates of the MRT were 120 and 0.7 Gy/s, respectively. Delivered doses were 96-960 Gy for MRT, and 24-120 Gy for BRT. Mortality was monitored for 90 days post-irradiation. Brain tissue was stained using hematoxylin and eosin to evaluate neural structure. Demyelination was evaluated by Klüver-Barrera staining. The LD50 and LD100 when using MRT were 600 Gy and 720 Gy, respectively, and when using BRT they were 80 Gy and 96 Gy, respectively. In MRT, mortality decreased as the center-to-center beam spacing increased from 100 µm to 300 µm. Cortical architecture was well preserved in MRT, whereas BRT induced various degrees of cerebral hemorrhage and demyelination. MRT was able to deliver extremely high doses of radiation, while still minimizing neuronal death. The valley doses, influenced by beam spacing and irradiated dose, could represent important survival factors for MRT [1].

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Mukumoto N, Nakayama M, Akasaka H, Shimizu Y, Osuga S, Miyawaki D, Yoshida K, Ejima Y, Miura Y, Umetani K, Kondoh T, Sasaki R. Sparing of tissue by using micro-slit-beam radiation therapy reduces neurotoxicity compared with broad-beam radiation therapy. J Radiat Res. 2016 Jul 15. [Epub ahead of print] PubMed PMID: 27422939.