Biological target volume based on DTI-MRI in postoperative chemoradiotherapy for glioblastoma

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Introduction Treating glioblastoma (GBM) effectively by surgery and postoperative radiotherapy (RT) is challenged by infiltrative growth preferentially along white matter tracts (WMT). Diffusion tensor imaging (DTI)-MRI can be used to model tumor probability along the WMTs. The aim of this phase 1 study is to evaluate a biological target definition based on DTI. Material/methods Forty-two GBM patients referred for postoperative RT were included between 10/2016 and 06/2018, and treated according to ESTRO-ACROP guidelines (CTV is isotropic 2 cm expansion around GTV). Treatment response was assessed using RANO criteria. Patients with new satellites (separate localisation outside GTV) were identified. An additional pre-radiotherapy DTI-MRI was performed to create two biological CTVs, isovolumetric to the treated CTV. Anisotropic margins were based on tensor directionality of γ0 and 20 (CTVγ0_20; higher γ means a higher presumed probability of tumor spread along WMTs). Dice similarity coefficient (DSC) was used for volumetric comparison of the target volumes. Overlap and Hausdorff distance 95% (HD) between the CTVs and the satellites were analysed to assess if the biological target volumes better predict for recurrence sites (2-sided paired Student's t-test). Results At a median follow-up of 11.7 (range 4-23) months, 30 patients had radiologic progression. In 10 of these, 19 satellites were identified. The respective mean (range) DSC of CTV vs. CTVγ0, CTV vs. CTVγ20 and CTVγ0 vs. CTVγ20 was 0.76 (0.58-0.9), 0.73 (0.59-0.9) and 0.9 (0.77-0.97). The CTV (partially) overlapped 8 satellites with a mean HD of 19.6 mm; the CTVγ0 and CTVγ20 both (partially) overlapped 11 satellites with a respective mean HD of 17.4 and 16.9 mm. This was significantly closer for CTVγ0 vs. CTV, p=0.048 (CTVγ20 vs. CTV p=0.058, CTVγ0 vs. CTVγ20 p=0.48). Conclusion DTI improved prediction of satellite localisations, and shows potential for an individualised biological target definition in GBM.