



Basic and Translational Investigations

Metabolism of diffuse intrinsic brainstem gliomas in children

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Abstract

Progress in the development of effective therapies for diffuse intrinsic brainstem gliomas (DIBSGs) is compromised by the unavailability of tissue samples and the lack of noninvasive markers that can characterize disease status. The purpose of this study was to compare the metabolic profile of DIBSGs with that of astrocytomas elsewhere in the CNS and to determine whether the measurement of metabolic features can improve the assessment of disease status. Forty in vivo MR spectroscopy (MRS) studies of 16 patients with DIBSG at baseline and after radiation therapy were retrospectively reviewed. Control data for baseline studies of DIBSGs were obtained from 14 untreated regular and anaplastic astrocytomas. All spectra were acquired with single-voxel, short echo-time (35 ms), point-resolved spectroscopy. Absolute metabolite concentrations (mmol/kg) and lipid intensities (arbitrary units) were determined. At baseline, creatine and total choline (tCho) were significantly lower in DIBSGs than in astrocytomas elsewhere in the CNS (4.3 ± 1.1 vs. 7.5 ± 1.9 mmol/kg, $p < 0.001$; 1.9 ± 0.7 vs. 4.2 ± 2.6 , $p < 0.001$). Serial MRS in individual subjects revealed increasing levels of tCho ($p < 0.05$) and lipids ($p < 0.05$) and reduced ratios of *N*-acetylaspartate, creatine, and myoinositol relative to tCho (all $p < 0.01$). Metabolic progression defined by increased tCho concentration in serial MRS preceded clinical deterioration by 2.4 ± 2.7 months ($p < 0.04$). Low tCho of DIBSG at baseline is consistent with low proliferative tumors. Subsequent metabolic changes that have been associated with malignant degeneration preceded clinical deterioration. MRS provides early surrogate markers for disease progression.

Key Words: brainstem gliomas, disease progression, metabolism, MR spectroscopy, pediatrics