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Proton MR spectroscopy shows improved performance to segregate high-grade astrocytoma subgroups when defined with the new 2021 World Health Organization classification of central nervous system tumors

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Abstract

Objectives: The 2021 World Health Organization (WHO) classification of central nervous system (CNS) tumors prioritizes isocitrate dehydrogenase (IDH) mutation to define tumor types in diffuse gliomas, in contrast to the 2016 classification, which prioritized histological features. Our objective was to investigate the influence of this change in the performance of proton MR spectroscopy (^{1}H-MRS) in segregating high-grade diffuse astrocytoma subgroups.

Methods: Patients with CNS WHO grade 3 and 4 diffuse astrocytoma, known IDH mutation status, and available ^{1}H-MRS were retrospectively retrieved and divided into 4 groups based on IDH mutation status and histological grade. Differences in ^{1}H-MRS between groups were analyzed with the Kruskal-Wallis test. The points on the spectrum that showed the greatest differences were chosen to evaluate the performance of ^{1}H-MRS in discriminating between grades 3 and 4 tumors (WHO 2016 defined), and between IDH-mutant and IDH-wildtype tumors (WHO 2021). ROC curves were constructed with these points, and AUC values were calculated and compared.

Results: The study included 223 patients with high-grade diffuse astrocytoma. Discrimination between IDH-mutant and IDH-wildtype tumors showed higher AUC values (highest AUC short TE, 0.943; long TE, 0.864) and more noticeable visual differences than the discrimination between grade 3 and 4 tumors (short TE, 0.885; long TE, 0.838).

Conclusion: Our findings suggest that ^{1}H-MRS is more applicable to classify high-grade astrocytomas defined with the 2021 criteria. Improved metabolomic robustness and more homogeneous groups yielded better tumor type discrimination by ^{1}H-MRS with the new criteria.

Clinical relevance statement: The 2021 World Health Organization classification of brain tumors empowers molecular criteria to improve tumor characterization. This derives in greater segregation of high-grade diffuse astrocytoma subgroups by MR spectroscopy and warrants further development of brain tumor classification tools with spectroscopy.

Key points: • The new 2021 updated World Health Organization classification of central nervous system tumors maximizes the role of molecular diagnosis in the classification of brain tumors. • Proton MR spectroscopy performs better to segregate high-grade astrocytoma subgroups when defined with the new criteria. • The study provides additional evidence of improved metabolic characterization of brain tumor subgroups with the new criteria.

Keywords: Central nervous system tumors; Cerebral astrocytoma; Magnetic resonance spectroscopy; Metabolomics; Neoplasm grading.