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Subventricular zone–associated classification in isocitrate dehydrogenase–wildtype glioblastomas: improved prognostic value through integration of FLAIR with contrast-enhanced imaging

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Abstract

Objective: Controversy surrounds the prognostic value of contrast-enhanced T1-weighted (T1CE) imaging-based subventricular zone (SVZ) classification in isocitrate dehydrogenase (IDH)-wildtype glioblastomas (GBMs). In this study, the authors aimed to assess the potential of incorporating FLAIR imaging into T1CE imaging-based classification for improving prognostic accuracy.

Methods: A retrospective analysis was conducted on 281 patients with IDH-wildtype GBM. T1CE imaging-based classification was performed, and T2-weighted/FLAIR imaging was integrated to evaluate its prognostic estimation ability. Based on the relationship between the tumors and SVZ, patients were categorized into SVZ+ and SVZ- cohorts based on T1CE and T2-weighted/FLAIR imaging findings. Kaplan-Meier and Cox proportional hazards regression analyses were used to assess progression-free survival (PFS) and overall survival (OS), respectively. Patients were then categorized into three subgroups based on their combined classifications: group 1 (SVZ+ on T1CE and T2-weighted/FLAIR imaging), group 2 (SVZ- on T1CE but SVZ+ on T2-weighted/FLAIR imaging), and group 3 (SVZ- on T1CE and T2-weighted/FLAIR imaging). Subgroup analysis was used to evaluate differences in clinical and molecular factors as well as in prognoses.

Results: The T1CE imaging-based classification failed to stratify OS between SVZ+ and SVZ- cohorts (16.0 vs 20.0 months, p = 0.36). Survival analysis revealed similar prognoses for patients in groups 1 and 2, and patients in group 2 exhibited worse OS compared with those in group 3 (19.0 vs 23.5 months, p = 0.024). Logistic regression identified lower Karnofsky Performance Status (KPS) (p = 0.011), tumor diameter (p = 0.002), and telomerase reverse transcriptase (TERT) promoter mutation (p = 0.003) to be associated with a higher incidence of group 2 GBMs. Additionally, T2-weighted/FLAIR imaging-based classification provided significant prognostic value (17.0 vs 23.5 months p = 0.021) and was found to be an independent prognostic factor in the Cox multivariate analysis (HR 1.79, 95% CI 1.08-2.96; p = 0.024).

Conclusions: This study underscores the limitations of T1CE imaging-based SVZ-associated classification in predicting prognosis for IDH-wildtype GBMs. The authors therefore propose an integrated approach that involves T2-weighted/FLAIR imaging that can provide improved prognostic ability. Notably, the presence of TERT promoter mutation was identified as a critical factor in nonenhancing tumor infiltration into the SVZ. Further validation through extensive cohort studies is recommended to confirm these findings.

Keywords: FLAIR; IDH; glioblastoma; subventricular zone; survival; tumor.