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Glioblastoma-Associated Epilepsy: An Exploratory Radiomic Analysis of MRI-Derived Morphological and Spatial Tumor Features

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Introduction

Epilepsy is a frequent complication in glioblastoma patients, contributing to morbidity and diminished quality of life, and may reflect underlying tumor biology. It remains difficult to predict using clinical parameters or visual MRI assessment alone. Although MRI data is routinely acquired, its value for anatomically informed assessment of epilepsy-related tumor characteristics remains underexplored. We investigated a retrospective glioblastoma cohort to determine if MRI-derived morphological and spatial tumor radiomic features can predict epilepsy.

Methods

We analyzed a retrospective cohort of 205 glioblastoma patients with multimodal MRI data (T1, T1CE, T2, FLAIR). Images were preprocessed and registered to the SRI24 reference space. Tumor segmentations were generated with top-ranked algorithms from the MICCAI BraTS challenge via BraTS Orchestrator. We extracted morphological and atlas-based spatial features describing anatomical localization. Associations with epilepsy were assessed via exploratory univariate analyses with false discovery rate (multiple-testing) correction.

Results

Exploratory univariate analyses revealed associations between several MRI-derived morphological and spatial markers and epilepsy occurrence. Enhancing tissue surface area ($\rho = -0.2999$, $p = 1.024 \times 10^{-5}$) was the only feature that remained significant after multiple testing corrections. Further associations were observed for enhancing tissue volume ($\rho = -0.2482$, $p = 2.899 \times 10^{-4}$) and the fraction of whole-tumor located in the left lateral orbitofrontal gyrus ($\rho = -0.2352$, $p = 6.065 \times 10^{-4}$).

Conclusion

MRI-derived morphological and spatial tumor features, particularly anatomical localization descriptors, are associated with epilepsy occurrence in glioblastoma and demonstrate the feasibility of an imaging-based, anatomically informed analytical framework. These hypothesis-generating findings provide a foundation for future multivariate studies integrating radiomic, clinical, and longitudinal data toward a more comprehensive characterization of tumor-associated epilepsy and its prognostic implications.