Deep Learning-Based Conventional MRI Sequences in Predicting Glioma Grading and IDH Status: A Comprehensive Systematic review and Meta-Analysis

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Background

Gliomas are heterogeneous group of brain tumors, are classified not only by histological features but also by molecular markers such as isocitrate dehydrogenase (IDH) mutation status. Gliomas are heterogeneous group of brain tumors, are classified not only by histological features but also by molecular markers such as isocitrate dehydrogenase (IDH) mutation status. Our aim is to group and testify the studies for assessing power of machine learning (ML) algorithms using cMRI in predicting histopathological grades and molecular biomarkers of glioma and to check the degree of variability a cross models.

Methods

We searched PubMed, Scopus, and IEEE databases up to November 2024. Inclusion criteria were studies that used T1W, T2W, FLAIR, and Post contrast T1 for training machine learning algorithms to classify IDH mutant Glioma from the wild type and high-grade gliomas from low grade gliomas which were confirmed by histopathology evaluation. Quality assessment of eligible studies was evaluated using QUADAS-2 tool. Statistical analysis was implemented using R software version 4.4.2.

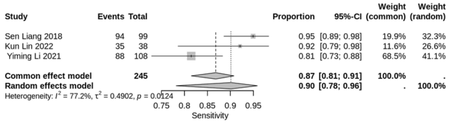
Results

Results: Thorough screening yielded five eligible studies with 685 patients. The pooled sensitivity and specificity of predicting high grade versus low grade glioma were 92.2% (95% CI: 85-96%) and 92.3% (95% CI: 83-97%). The diagnostic odds ratio (DOR) was 175 (95% CI: 22-288). The positive and negative likelihood ratios were 9.4 (95% CI: 5.1-11.6) and 0.11 (95% CI: 0.03-0.18), respectively. Furthermore, the performance of AI models in predicting IDH mutant glioma and wild type variant were 80% (95% CI: 34-97%) for sensitivity and 86% % (95% CI: 80-91%) for specificity. The positive and negative likelihood ratios were 5.83 (95% CI: 1.65-10.80) and 0.23 (95% CI: 0.03-0.83), respectively. The DOR was 25.6 (95% CI: 5.1-130.6).

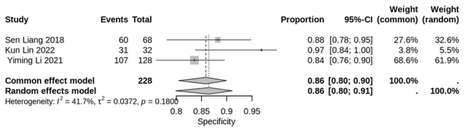
Conclusion

Conclusion: This study demonstrates a high predictability of AI-models in differentiating high grade and IDH mutant gliomas. We observed high variability across the studies (Heterogeneity I 2 > 75%), therefore we recommend a longitudinal well controlled study to validate these result for potential utility of these models in clinical decision making.

Sensitivity of HG vs LG Glioma



Specificity of HG vs LG Glioma



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Conflict of interest

No conflict of interest to declare.

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