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ORIGINAL ARTICLE

Assessing glioma grading with self-attention: comparative analysis of the diagnostic potential of different MRI sequences

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Abstract Gliomas are a type of primary brain tumour which exhibit high variability in terms of histological characteristics and clinical behaviour. Accurate classification of gliomas plays a crucial role in prognosis, treatment planning, and patient management. We propose a novel approach for glioma classification using a self-attention mechanism, demonstrating promising results in capturing intra-slice dependencies within 3D volumetric MRI data due to its ability to capture dependencies in sequential data. Additionally, our study offered a unique comparison of the performances of different MRI sequences on glioma grading. We trained and evaluated our model on 365 MRI scans consisting of four MRI contrasts (T1, T2, T1ce, Flair) of the BraTS-19 dataset. Our findings reveal that self-attention performs well in classifying gliomas into HGG and LGG with T1-weighted sequences comparatively performing best in classifying gliomas with an overall accuracy of 95.52% and an AUC ROC score of 0.92. This study contributes to advancing glioma classification methodologies, highlighting the potential of self-attention mechanisms in capturing complex dependencies within MRI data and demonstrating the importance of selecting appropriate MRI sequences for accurate glioma grading, with implications for improving clinical decision-making in glioma management.

Keywords Deep learning · Self-attention · Magnetic resonance imaging · Gliomas · Radiomics · Diagnostics

1 Introduction

Gliomas represent a significant medical challenge due to their intricate histological diversity and wide-ranging clinical behaviours. Glioma is the most common type of tumour in the Central Nervous System (CNS). Gliomas account for 80% malignant and 30% of all brain tumours in CNS (Goodenberger and Jenkins 2012). These primary brain tumours originate from glial cells and encompass various subtypes, each characterised by distinct genetic and molecular profiles (Parpura et al. 2012). Accurate classification of these tumours is paramount in neuro-oncology, with its role being pivotal in prognosis estimation, formulating the treatment strategy, and patient management.

Over the years, numerous classification methods have been explored, driven by the imperative to enhance diagnostic precision and patient care. Historically, glioma classification has relied heavily on assessing histological characteristics like cell type, cellularity, mitotic activity, etc. Bailey and Cushing (1925); Louis et al. (2021). These approaches, although informative, are often constrained by their invasive

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