Chapter 8

Brain Cancer Survival Glioblastoma Patient Based on Graph Analysis Network

Er. Naveen Dogra[1], Er. Gurpreet Singh[2]

[1,2]University Institute of Engineering & Technology, Panjab University SSG Regional Centre, Hoshiarpur, Punjab, India.

E-mail: naveendogra@pu.ac.in, er.gpsbains78@pu.ac.in

ABSTRACT

Glioblastoma (GBM) remains a highly aggressive brain tumour with limited treatment options and poor patient outcomes. In this paper, we present a novel model called RAGA-Net for predicting overall survival (OS) of patients with IDH-wildtype GBM which systematically integrates radiomics, attention mechanisms and graph-based analysis. RAGA-Net employs the use of multi-parametric MRI scans (T1, T2, FLAIR, T1GD) and extracts radiomic features with graph features aiding the understanding of GBM heterogeneity. It also uses clinical data to create spatial relationships within tumours but relies on attention mechanisms to further the understanding of relevant aspects of the study. This way, a model is built with high accuracy, surpassing prior methods, and supporting personalized treatment strategies for GBM.

To support early interventions, this study examines the predictive power of regional radiomics similarity networks (R2SNs) in preoperative GBM survival predictions using routine MRI. Unlike standard MRI-based radiomics that often isolate specific regions, R2SNs account for inter-regional relationships via radiomics similarity, enhancing survival predictions. Specifically, a novel distance correlation-based R2SN (DC-R2SN) is introduced, leveraging distance correlation for complex interaction measurement among brain regions. A graph neural network (GNN) framework integrates DC-R2SNs with clinical data for OS prediction. Testing on the UPenn-GBM dataset highlights the GNN framework's effectiveness, underscoring its utility in clinical decision-making for GBM patients. This approach aims to empower healthcare providers with precise, tailored insights to improve patient care and outcomes.

Keywords: Attention mechanism; Graphical analysis; Radiomic; GNN; Glioblastoma.

1. Introduction

Gliomas are the most prevalent type of primary tumors affecting the central nervous system, including the brain and spinal cord. Histologically, these tumors resemble glial cells—the supportive cells in the nervous system-but their exact cellular origins remain elusive and have long been a subject of scientific investigation [2]. Gliomas may potentially arise from a variety of cell types, such as mature glial cells, neural progenitor cells, or stem cells, and this ambiguity reflects their complex biology and heterogeneous nature. Historically, the classification of gliomas relied on the 2007 World Health Organization (WHO) framework, which was primarily based on histopathological assessment. Under this system, gliomas were graded from