

ASSOCIATION BETWEEN INTENSITY AND VOLUME OF TUMOR SUB-REGIONS IN T2 AND FLAIR MR IMAGES OF GLIOBLASTOMA MULTIFORME

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ABSTRACT

In this study, correlation between volume of tumor sub-regions and their corresponding Magnetic Resonance (MR) image intensities of patients of Glioblastoma Multiforme (GBM) are analyzed. For this, FLAIR and T2-weighted MR images are considered from a public dataset. The segmented images of tumor sub-regions, namely necrotic core, edema and enhancement tumor, are also obtained from the dataset. Volume and mean intensity features are extracted from sub-regions. These images are categorized into 4 Sub-Groups (SG) namely SG_1, SG_2, SG_3 and SG_4 based on their volume. Spearman correlation coefficient (r) is employed to investigate association between volume and intensity feature. Statistical tests are employed to identify significance between differences in the r-values. Results indicate that there is significant correlation between edema volume and mean intensity in both FLAIR ($r = 0.868$) and T2-weighted ($r = 0.773$) MR images. In SG analysis, maximum correlation is attained in SG_1. For T2-weighted images, it is observed that r-value decreases with increasing edema volume, and the least correlation is found in SG_4. Correlation between volume and intensity features does not follow a linear trend in FLAIR images. In all tumor sub-regions, it is found that FLAIR sequence exhibits significantly higher correlation compared to T2 in SG_1. The proposed study indicates that the mean intensity feature is significantly associated with volume of tumor sub-regions extracted from MR images of GBM patients irrespective of the variations in tumor size. Thus, both intensity and volume features may be useful for automated diagnosis of GBM stages.

Keywords: Glioblastoma, Structural MR imaging, Edema, Statistical Test, Volume, Image Intensity

INTRODUCTION

Glioblastoma Multiforme (GBM) is the most predominant and highly aggressive brain tumor characterized by its high mortality rate [1]. The disease affects about 26.5% of the population with an estimated median survival of 12–15 months. The incidence of GBM increases with age and its prevalence is found to be higher in the Caucasian population than in other ethnicities. The standard approach for GBM treatment typically involves surgery followed by radiation therapy. However, the treatment response is highly affected by the varying degrees of heterogeneities within the GBM tumors. Recent studies have reported intra-tumoral heterogeneities in GBM, suggesting that the discrete tumor sub-regions reflect differential and clinically relevant information. The most widely studied GBM sub-regions include Necrotic Core Region (NCR), Edema (ED) and Enhancing Tumor (ET) [2].

Glioblastoma sub-regions have been analyzed using sensitive markers obtained from different neuroimaging modalities. Among these modalities, structural Magnetic Resonance (MR) brain images are extensively employed in GBM diagnosis [3]. This is due to their ability to capture detailed and high-