Comparison of Image Features of Glioblastoma and Meningioma Using Magnetic Resonance Images

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Glioblastoma is the most common malignant brain tumor type, while meningioma is benign. Non-invasive, computer-based differentiation is beneficial in identifying these tumor types. Extraction and analysis of quantitative image features from MRI images can support distinguishing between them. Since conventional methods have limitations in differentiation, there is a need for non-invasive, reliable, and automated methods to aid in identification. The main objective of this study was to compare image features between glioblastoma and meningioma to accurately classify Meningioma and Glioblastoma tumors and thereby to reduce human error in the diagnosis. This quantitative study was conducted using 70 glioblastoma and 70 meningioma brain MRI images (both contrast-enhanced and non-contrast T1-weighted), obtained from The Cancer Imaging Archive (TCIA) website. ImageJ DICOM reader was used to view and select slices, and MATLAB software was used for segmentation and feature extraction. Segmentation was performed using two approaches: manual segmentation was applied when the tumor involved multiple tissue regions, while automated segmentation was used otherwise, based on a fixed intensity threshold value of 70.A total of 20 features were extracted: 7 texture properties, 6 Gray Level Co-occurrence Matrix (GLCM) properties, and 7 Hu's moment invariants. Data analysis was performed using Excel. Features were tested for normality, and only normally distributed features were selected for comparison. Comparisons were conducted separately for contrast-enhanced and non-contrast images based on the means of the selected features. Statistical significance of difference of means was determined using an independent samples t-test at a threshold of $P < 0.05$. For contrast-enhanced images, 9 features showed significant differences: 2 texture properties (average grey level, standard deviation), 3 GLCM features (correlation, homogeneity, entropy), and 4 Hu's moment invariants (moments 1, 2, 3, and 4). For non-contrast images, 3 features showed significant differences: 1 texture property (entropy) and 2 GLCM features (contrast, homogeneity). Since these features show significant differences between glioblastoma and meningioma, they can be considered useful for the non-invasive differentiation of these tumor types.

Keywords: Glioblastoma, meningioma, texture properties, invariant moment, GLCM