Glioblastoma radiomics

Radiomics analysis has had remarkable progress along with advances in medical imaging, most notability in central nervous system malignancies. Radiomics refers to the extraction of a large number of quantitative features that describe the intensity, texture and geometrical characteristics attributed to the tumor radiographic data. These features have been used to build predictive models for diagnosis, prognosis, and therapeutic response. Such models are being combined with clinical, biological, genetics and proteomic features to enhance reproducibility. Broadly, the four steps necessary for radiomic analysis are: (1) image acquisition, (2) segmentation or labeling, (3) feature extraction, and (4) statistical analysis. Major methodological challenges remain prior to clinical implementation. Essential steps include the adoption of an optimized standard imaging process, establishing a common criterion for performing segmentation, fully automated extraction of radiomic features without redundancy, and robust statistical modeling validated in the prospective setting. This review walks through these steps in detail, as it pertains to High-grade gliomas [1)]

Sixty-eight <65 years old Glioblastoma patients, with extensive CET resection, were selected. Resection was evaluated by manually segmenting CET on volumetric T1-weighted MRI pre and postsurgery (within 72 h). All patients underwent the same treatment protocol including chemoradiation. NET radiomic features were extracted with a custom version of Pyradiomics. Feature selection was performed with principal component analysis (PCA) and its effect on survival tested with Cox regression model. Twelve months OS discrimination was tested by t-test followed by logistic regression. Statistical significance was set at $p<0.05$. The most relevant features were identified from the component matrix.

Results: Five PCA components (PC1-5) explained 90% of the variance. PC5 resulted significant in the Cox model ($p = 0.002$; $\exp(B) = 0.686$), at t-test ($p = 0.002$) and logistic regression analysis ($p = 0.006$). Apparent diffusion coefficient (ADC)-based features were the most significant for patient survival stratification.

Conclusions: ADC radiomic features on NET predict survival after standard therapy and could be used to improve patient selection for more extensive surgery [2)]

1)
Chaddad A, Kucharczyk MJ, Daniel P, Sabri S, Jean-Claude BJ, Niazi T, Abdulkarim B. Radiomics in Glioblastoma: Current Status and Challenges Facing Clinical Implementation. Front Oncol. 2019 May 21;9:374. doi: 10.3389/fonc.2019.00374. PMID: 31165039; PMCID: PMC6536622.

2)
Pasquini L, Di Napoli A, Napolitano A, Lucignani M, Dellepiane F, Vidiri A, Villani V, Romano A, Bozzao A. Glioblastoma radiomics to predict survival: Diffusion characteristics of surrounding nonenhancing tissue to select patients for extensive resection. J Neuroimaging. 2021 Jul 7. doi: 10.1111/jon.12903. Epub ahead of print. PMID: 34231927.