Supplementary Material

Title: Application of Deep Learning on MRI for Discriminating Glioma Recurrence from Radiation Necrosis: Algorithm Development and Validation

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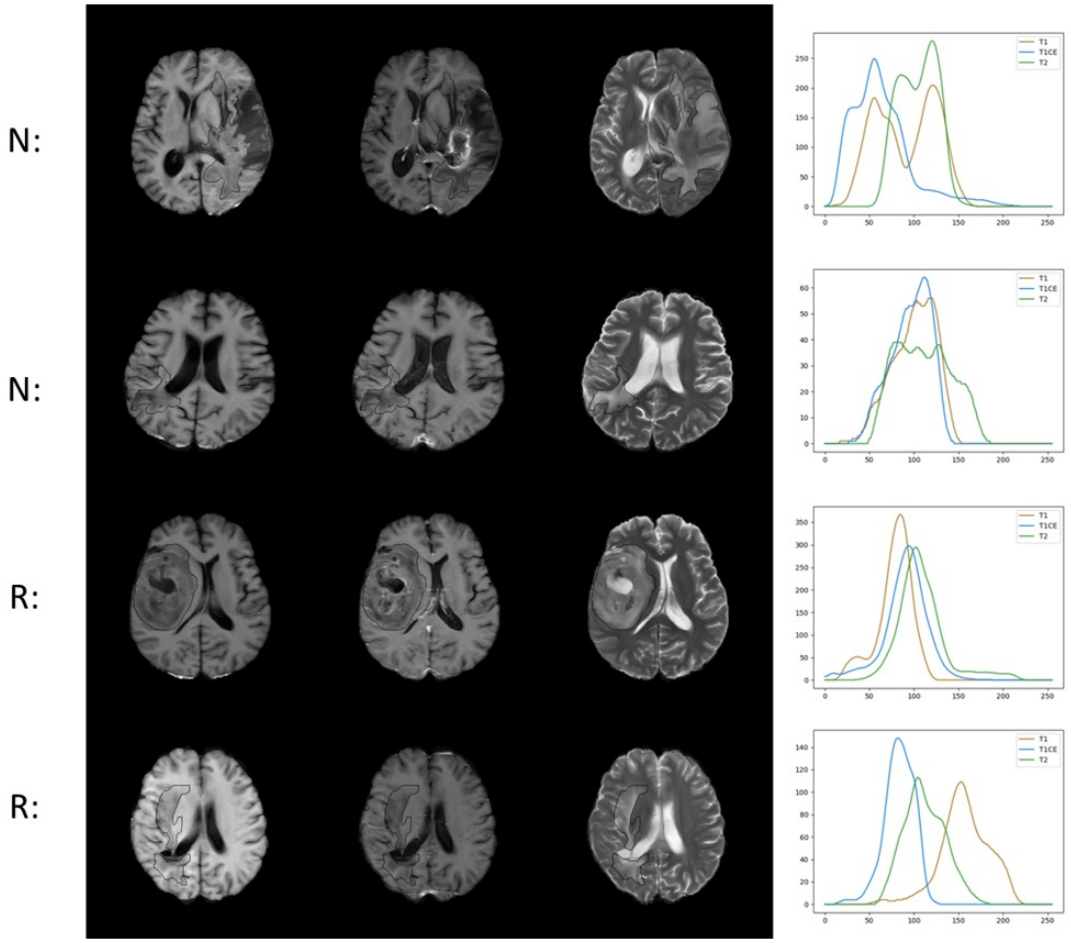
Abbreviation: CNN=Convolutional Neural Network; AUC=Area Under the Receiver Operating Characteristic Curve; GBM=Glioblastoma; PWI=Perfusion-Weighted Imaging; MRS=Magnetic Resonance Spectroscopy; DWI=Diffusion-Weighted Imaging; PET=Positron Emission computed Tomography; ROIs=Regions of Interest; DNN=Deep Neural Network; ROC=Receiver Operating Characteristic; CI= confidence interval; Grad-CAM=Gradient-weighted Class Activation Mapping; rCBV=relative Cerebral Blood Volume; Cho/Cr=Choline/Creatinine; SPECT=Single-Photon Emission Computed Tomography; H1-MRS=proton Magnetic Resonance Spectroscopy; NAA=N-acetylaspartic Acid; ATRX=Alpha-Thalassemia/Mental Retardation Syndrome; FLAIR=Fluid Attenuated Inversion Recovery

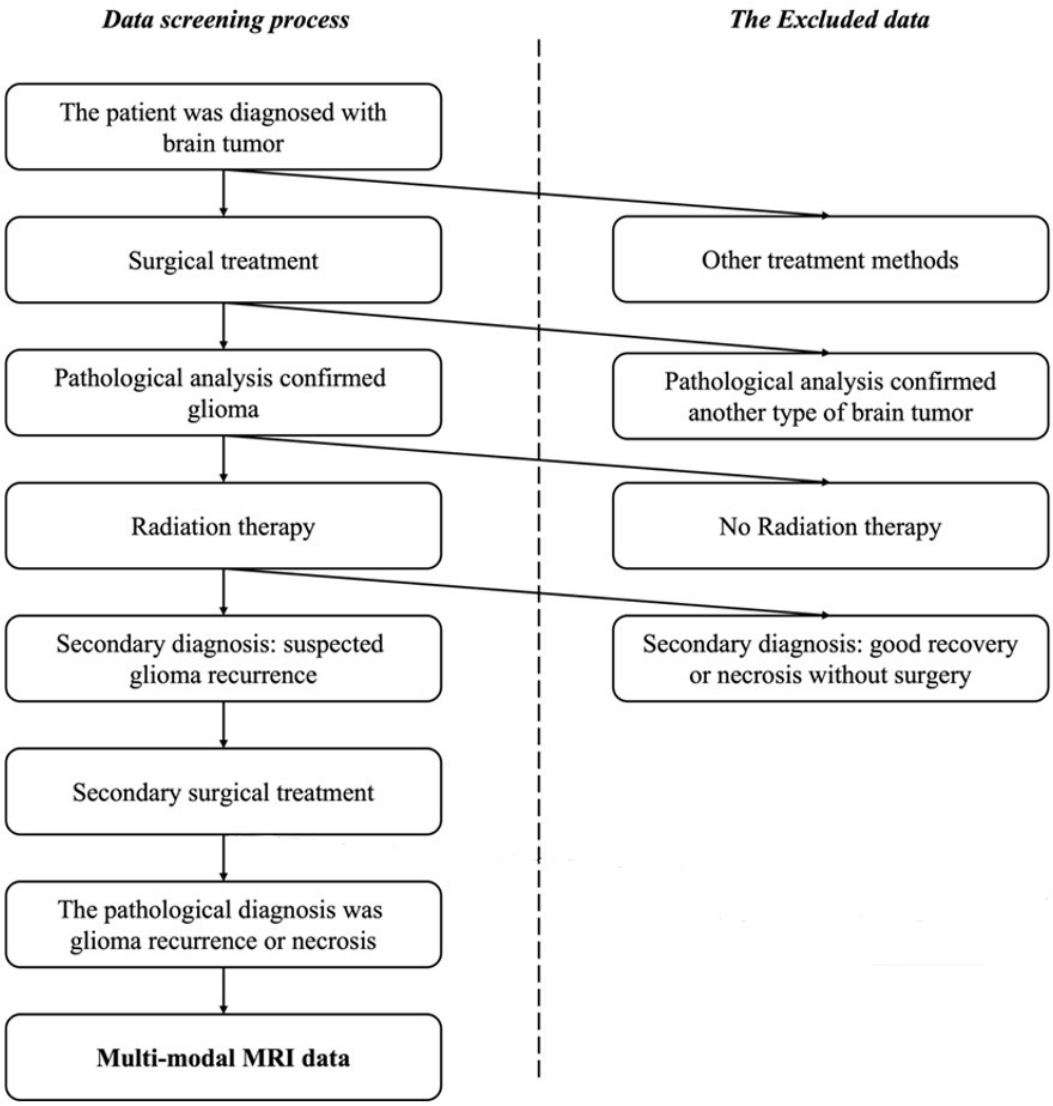
Supplementary Figure1

2D MRI sequence slices of T1, T2, and T1ce modes and voxel histograms within the lesion area of four patients marked by the neurosurgeon. N represents patients diagnosed with necrosis, and R represents patients diagnosed with glioma recurrence. The lesion masks were manually drawn using the software ITK-SNAP, generally used for delineating regions of interest. The histograms were created for individual sequences and further smoothed using the Hann filter. But the process is time-consuming.



Supplementary Figure2

The selection process for the patient cohorts in this study. Patients with a confirmed pathological diagnosis, a history of radiotherapy, previous glioma diagnosis, and conventional MRI sequence data were enrolled while the patients without pathological examination results or missing conventional MRI sequence data were excluded, as well as patients with primary glioma or no history of radiation therapy.



Supplementary Figure3

Overview of the proposed approach. The Pipeline of the CNN network was trained using 3D MRI sequences, abstracting low-level image features into high-level semantic features through cascaded layers of convolution and pooling. A fully connected layer is employed to perform the final classification task, yielding the diagnosis outcome. During supervised learning, the network's classification results (radiation necrosis/tumor recurrence) are measured against the ground truth using loss calculation.