MEMORANDUM AND EVIDENCE REPORT

RISK FACTORS FOR DIFFUSE MIDLINE GLIOMA:

Xinyang Liu1, Zhifan Jiang1, Holger R Roth2, Syed M Anwar1, Erin R Bonner1, Roger J Packer1, Anahita F Kazerooni3,4, Miriam Bornhorst1,3, Marius George Lingurar1,2, Children’s National Hospital, Washington, DC, USA, 2NVIDIA, Herndon, VA, USA, 3Children’s Hospital of Philadelphia, Philadelphia, PA, USA, 4University of Pennsylvania, Philadelphia, PA, USA, 5Ann & Robert H. Lurie Children’s Hospital of Chicago, Chicago, IL, USA, 6George Washington University, Washington, DC, USA

BACKGROUND: Pediatric diffuse midline gliomas (DMG) are aggressive central nervous system tumors with a median overall survival (OS) of less than one year from diagnosis. There is no curative therapy for DMG, and radiation therapy (RT) is the standard treatment. Magnetic resonance imaging...
(MRI) is the common noninvasive tool for DMG diagnosis and monitoring of tumor response to therapy. We developed an automatic pipeline to segment subregions of DMG and select MRI features that predict patient OS. METHODS: We acquired diagnostic and post-RT multisquence MRI (T1, T1ce, T2, T2 FLAIR) and manual segmentations of pediatric DMG patients from two centers: 53 from Children’s National Hospital (internal) and 16 from Children’s Hospital of Philadelphia (external). We pretrained a deep learning model on a public adult brain tumor dataset, and finetuned the model to segment tumor core (TC) and whole tumor (WT) of DMG. We used PyRadiomics and sequential feature selection to select discriminative features based on the segmented volumes. Two machine learning models were trained on our internal cohort to predict patient 1-year survival from diagnosis. One model used only diagnostic tumor features and the other used both diagnostic and post-RT features. RESULTS: For segmentation, Dice score (mean [median]±SD) was 0.91 (0.94)±0.12 and 0.74 (0.83)±0.32 for TC, and 0.88 (0.91)±0.07 and 0.86 (0.89)±0.06 for WT for internal and external cohorts, respectively. For OS prediction, accuracy was 77% and 81% at time of diagnosis, and 85% and 78% post-RT for internal and external cohorts, respectively. Heterogeneous WT intensity in baseline T2 FLAIR and smaller post-RT TC/WT volume ratio indicate longer OS. CONCLUSIONS: Our method accurately predict OS for DMG patients and can be extended to other rare pediatric brain tumors. With automated and standardized analysis, early prognostication of OS can guide patient risk stratification and clinical decisions.