for pre-operative assessment of a glioblastoma's molecular characteristics. These non-invasive radiogenomic biomarkers may be useful for understanding the molecular composition of a glioblastoma prior to surgical resection, thus enabling earlier selection of patients for targeted therapy trials and possible neoadjuvant treatment.

### NIMG-41. VARIATION IN PERFUSION AND PERMEABILITY MRI DEPENDING ON VASCULAR INPUT FUNCTION SELECTION

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BACKGROUND: According to the updated RANO criteria, MRI contrast enhancement and peritumoral edema during the initial 12 weeks within the radiation field following chemoradiation may be pseudoprogression (PP) or true progression (TP). This ambiguity results in diagnostic uncertainty and delays in effective therapies. MRI perfusion and permeability imaging markers, including relative blood volume (rBV), and volume transfer constant (Ktrans), may be useful in differentiating PP from TP. Both techniques rely on identification of a vascular input function (VIF) to produce reliable output maps. METHODS: Perfusion and permeability maps were acquired from 7 patients on a Siemens 3T Verio MRI as part of an ongoing prospective study on glioblastoma multiforme. Patients received standard surgical resection with concurrent chemo-radiotherapy treatment and MRI follow-up at one and every 2 months. Maps were based on the follow-up MRI. The 3D contrast enhancing lesion (CEL) was segmented from the T1-Post-Gd MRI. VIF pixels were identified in the internal carotid artery (ICA), the M2 segment of the middle cerebral artery (MCA2), the superior sagittal sinus (SSS), automatically using software (Olea Sphere 3.0.22), and auto-edited (removed pixels from the auto VIF definition that were outside the brain). RESULTS: For the different VIF pixel selections (ICA, MCA2, SSS, Auto, Auto-edited), mean Ktrans values from CEL were 0.32, 0.48, 0.05, 0.09, 0.08, respectively, showing a 10-fold variation. Mean rBV values from CEL were 2.70, 2.36, N/A, 3.10, 3.19, respectively, showing a 1.3-fold variation. CONCLUSIONS: VIF pixel selection is a critical step in generating reliable perfusion and permeability MRI maps. Variation of up to a factor of 10 in the Ktrans values, depending on VIF selection, was observed. SSS for the permeability VIF resulted in maps that most closely matched literature values, whereas perfusion imaging showed less sensitivity to VIF selection.

### NIMG-42. HOROS SOFTWARE FOR POSTOPERATIVE ANALYSIS OF PEDIATRIC HIGH-GRADE GLIOMAS

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INTRODUCTION: Horos (LGPL 3.0) is a free, open source medical image viewer that has gained attention in the neurosurgical community because of the familiar OsiriX-based interface and its useful three-dimensional (3D) volumetric rendering capabilities. We present the use of Horos software as a postoperative tool for residual tumor volume analysis in children with high-grade gliomas. METHODS: A retrospective study of 11 pediatric patients with histologically confirmed HGG underwent tumor resection (n=8) or biopsy (n=3) as definitive treatment from 6/2011 to 6/2019. Volumetric data and extent of resection were obtained via region of interest-based 3D analysis using Horos image-processing software. Age, initial tumor volume, extent of resection, and postoperative residual volume were assessed as predictors of overall survival or event free survival. TECHNIQUE: Region of interest (ROI) segmentation was performed utilizing the "Closed Polygon Tool" to outline the tumor and the "Generate Missing ROIs" function to capture the entirety of the tumor within the MRI series. The "Computer Volume" function was used to render the 3D tumor volumes. The preoperative and postoperative tumor volumes were compared per patient to yield the percent extent of resection and residual volume. RESULTS: The Horos software is a highly effective means of volumetric analysis for high-grade gliomas depicted in T1 and T2 MRI series. In our series, eight (73%) patients underwent tumor resection and three (27%) underwent biopsy. Patients who underwent resection were older than biopsy patients [12 (8-18) vs. 9 (8-21) years old]. Age, initial tumor volume, extent of resection, and postoperative residual volume were not significant predictors of overall survival or event free survival. CONCLUSION: Horos software provides increased accuracy and confidence in determining post-operative volume and is useful in assessing the impact of residual volume on outcome after maximal safe resection in pediatric patients with high-grade gliomas.

### NIMG-43. IMAGING FINDINGS FOLLOWING REGORAFENIB IN PATIENTS WITH MALIGNANT GLIOMA: FET PET ADDS VALUABLE INFORMATION TO ANATOMICAL MRI

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BACKGROUND: Recent phase 2 data showed that the small molecule regorafenib with antiangiogenic properties has promising effectivity in glioblastoma patients at first progression. Following antiangiogenic therapy with bevacizumab, amino acid PET provides valuable additional diagnostic information regarding bevacizumab-related effects on MRI (e.g., pseudoresponse). In contrast, only a little is known about regorafenib. Thus, we evaluated prospectively the value of O-(2-[$^{18}$F]fluoroethyl)-L-tyrosine (FET) PET for the assessment of regorafenib-related treatment effects. METHODS: Twenty-two patients with progressive malignant glioma (median number of relapses, 2; range, 1-4) were included. Up to now, 10 of 22 patients were eligible for data evaluation and underwent regorafenib therapy (median number of cycles, 2; range, 1-5 cycles). FET PET and MRI were performed at baseline and after the second cycle. After the second cycle, MRI was performed every 8 weeks. In case of a suspicious MRI after the second cycle, a FET PET scan was added. MRI changes were evaluated according to the RANO criteria. Maximum tumor-to-brain ratios ($TBR_{max}$) were calculated. Pseudoresponse was considered if (i) the follow-up MRI showed an improvement (i.e., at least "partial response" according to RANO criteria) despite subsequent clinical progression, and (ii) an increase of $TBR_{max}$>25% occurred. Pseudoresponse was confirmed if (i) the subsequent MRI follow-up showed progression, and/or (ii) the clinical status worsened, or the patient died. RESULTS: In 4 of 10 patients, FET PET provided clinically relevant additional information. In two patients, pseudoresponse could be confirmed. Furthermore, in one patient with stable disease according to MRI, increasing $TBR_{max}$ (+138%) enabled earlier diagnosis of tumor progression (time benefit, 5 weeks). In another patient without signs of MRI response after 2 cycles, decreasing $TBR_{max}$ (-23%) indicated metabolic response and was associated with a significant clinical improvement. CONCLUSIONS: FET PET seems to add valuable diagnostic information for regorafenib therapy monitoring.

### NIMG-44. INTEGRATING AUTOMATED LESION SEGMENTATIONS FROM SINGLE-IMAGES INTO ROUTINE CLINICAL WORKFLOW FOR VOLUMETRIC RESPONSE ASSESSMENT

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INTRODUCTION: Volume calculations have not been adopted into glioma response assessment due to lengthy times for manual definition and unreliable measures provided by automated algorithms. Relatively new artificial intelligence approaches such as convolutional neural networks have significantly improved lesion segmentation with performance accuracies >90%. However, their adoption into routine practice remains limited due to poor generalizability and failure rates approaching 25% when incorporated into clinical workflow. The latter can be attributed to 1) the requirement of four different types of anatomic images (T2, T2-FLAIR, T1 pre- and post-contrast); 2) cumbersome preprocessing including alignment, reformatting, and skull removal; and 3) the lack of a well-integrated clinical deployment system. The goal of this study was to demonstrate how simple modifications to a robust network coupled with an integrated workflow can provide reliable measures of tumor volume for real-time use in the reading room. METHODS: Leveraging NVIDIA's Clara-Train software and a molecularly diverse dataset of 400 labeled images for training, we modified a top-performing ensembled 2D-U-Net to require a single image-volume input (T2-FLAIR or post-contrast T1 for the T2-hyperintense or contrast-enhancing lesions) and deployed the results in the clinic to provide quantitative volumetrics. Inference was performed on a mix of image orientations without any reformatting or skull-stripping. RESULTS: Training on only 115 of our 400 datasets, we achieved Dice Coefficients of 90% and 81% overlap of our auto-segmented T2 and contrast-enhancing lesions with manual labels in our 25-patient validation cohort (11 enhancing), compared to 91% and 83% overlap with the original model that required four anatomic images to segment each lesion. Radiologists can view segmentations directly from PACS as contours or overlays and provide numerical feedback for model refinement. The workflow has been applied on 50 cases to date without any failures and can be easily shared for deployment on any clinical PACS.