Regional Metabolic Analysis of Neurological Recovery After Brain Metastasis Resection Using Automated Analytic Software

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Introduction

Brain metastases can cause significant neurological dysfunction, with presentation varying with lesion location. Software may be used to perform a quantitative regional analysis of a PET/CT scan to identify regions of increased or decreased metabolism that may reflect neurological remodeling in response to metastatic lesions. This study pioneers the utilization of MIMneuro (MIM Software, Inc., Cleveland, OH, USA) for the characterization of changes in global brain metabolism in the setting of brain metastasis based on 18-fluorodeoxyglucose(FDG) PET/CT imaging.

Methods

Our study participant is a 66-year-old male patient with a history of stage IV melanoma status post resection of brain metastasis. The patient underwent a baseline MRI 1 week prior to brain resection as well as 18-FDG PET/CT imaging 1 week after. We utilized MIMneuro version 7.1.5 with an integrated anatomic atlas to conduct a comprehensive regional brain metabolism analysis in 70 distinct brain regions. Regions within or spatially adjacent to the site of the lesion were excluded.

References:
1. Rishi A, Yu HM. Current Treatment of Melanoma Brain Metastasis. Curr Treat Options Oncol. 2020 Apr 30;21(6):45.
2. Dronkers NF, Wilkins DP, Van Valin RD Jr, Redfern BB, Jaeger JJ. Lesion analysis of the brain areas involved in language comprehension. Cognition. 2004 May-Jun;92(1-2):145-77.

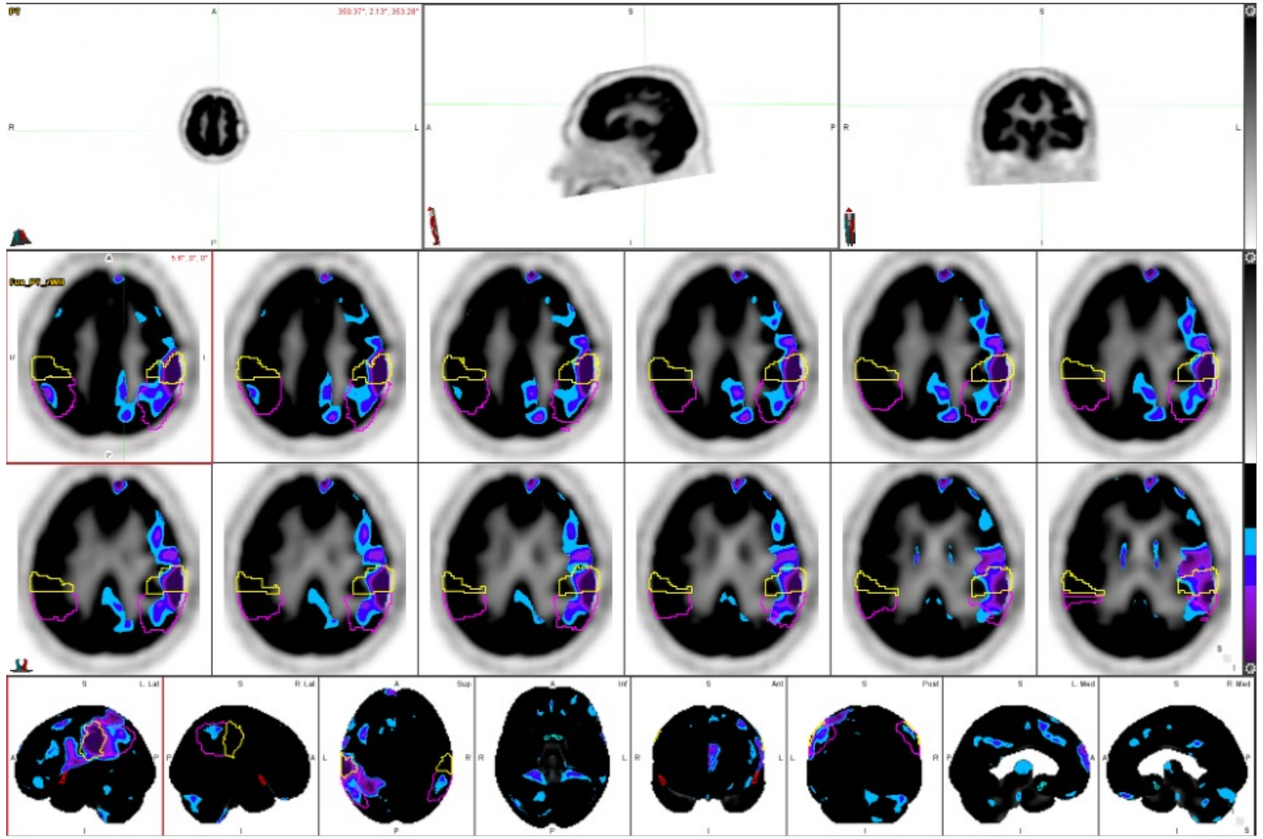

Figure 1 – Evaluation of 18-FDG-PET through quantitative analysis using MIMNeuro version 7.1.5 (MIM Software, Inc., Cleveland, OH, USA). Low 18-FDG uptake is represented by purple and blue contours. The nucleus accumbens (blue), angular gyrus (yellow), supramarginal gyrus (pink), and temporal operculum (red) have been delineated as regions of interest in this patient.

Results

Baseline MRI showed a focally enhancing 12 mm nodule with moderate vasogenic edema in the left parietal frontal lobe consistent with metastasis. 18-FDG PET/CT showed no evidence of FDG-avid malignancy and demonstrated significant hypometabolism in the left supramarginal gyrus (z= -9.85) and left angular gyrus (z= -4.85). Significant hypermetabolism was evident in the right temporal operculum (z= 2.08) and bilateral nucleus accumbens (z= 2.24).

Conclusions

The angular and left supramarginal gyri are implicated in language processing and phonological word choice - hypometabolism in these regions may reflect weakened language processing on the left side. Hypermetabolism in the right temporal operculum, which contains the right primary auditory cortex, may reflect compensation in language processing by the right hemisphere.

Our results demonstrate the potential of quantitative analysis software to characterize functional changes in brain metabolism using 18-FDG PET/CT imaging; this may aid in tracking of recovery of neurological function post surgical resection of metastatic brain lesions.