^{18}F-DOPA PET Scan mapped with radiotherapy dosimetry for the management of tumor recurrence versus radiation necrosis in high grade gliomas: an institutional experience"

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Background

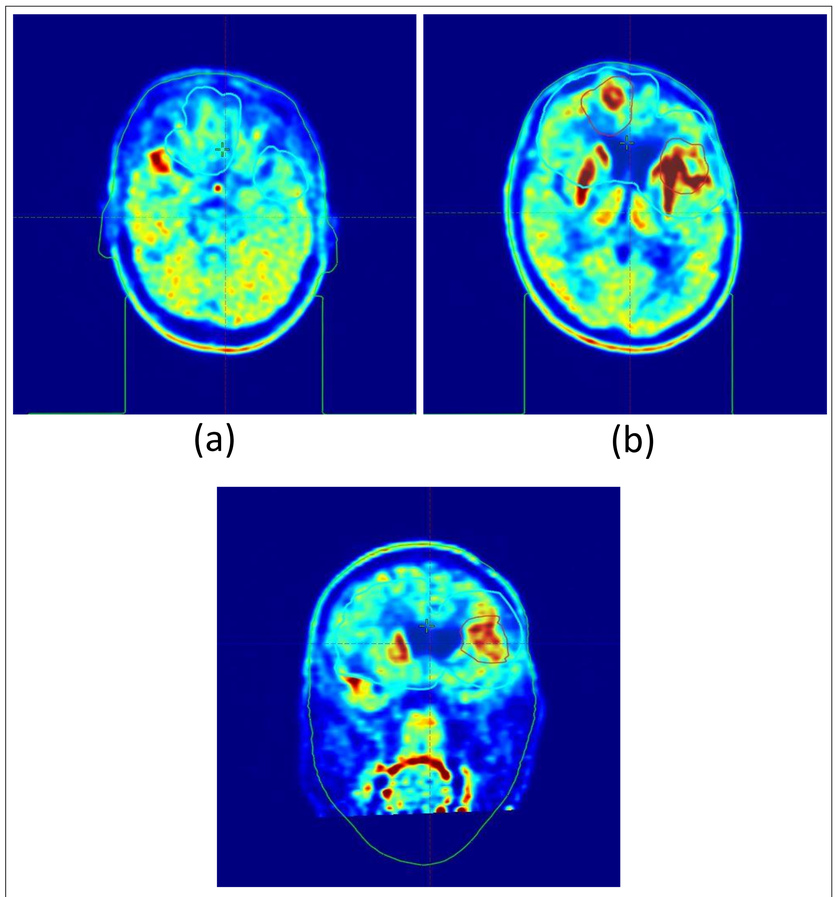
- Patients with High grade glioma (HGG) who underwent chemoradiation usually have routine Magnetic Resonance Imaging (MRI) every 2-3 months for surveillance.
- Quite often, the treatment related changes including radiation necrosis (RN) and pseudo-progression (PP) are indistinguishable from tumor recurrence (TR), which can cause significant **dilemma** to the treating physician.

Research Objectives

The main aim of this study is to investigate the utility of Fluoro-dihydroxyphenylalanine Positron Emission Tomography (^{18}F -DOPA PET) scan mapped with radiotherapy planning dosimetry in differentiating true progression from RN and PP during follow up, and the potential application in further treatment management.

Materials and Methods

- We retrospectively reviewed ten accrued HGG patients over a duration of 12 months, who were initially treated with concurrent chemoradiation and found to have clinical and/or MRI changes suggesting TR or RN on follow up. Each patient underwent a ^{18}F-DOPA PET scan and the images were mapped with the corresponding CT and MRI radiotherapy plan.
- We then analyzed the overlap of fused images with the contours of primary tumor and target volumes. Descriptive analysis was used to identify TR and RN, and patterns of correlation with dosimetry.



(a) (b) (c)

Figure 1: ^{18}F-DOPA PET MRI scan images showing recurrent GBM tumor outside the high dose treated volume. (a) axial; recurrent disease (b) axial; previous treated volume (c) coronal

Results

- ^{18}F-DOPA PET scan identified TR in eight patients and RN in two patients. Majority of scans identified progression based on PET metabolic uptake. Tumor progression was identified inside the PTV target volume in four patients. Tumor progression outside the high dose volume was identified in one patient and at marginal borders of targets in three patients. We found the mirror symmetry of PET finding inside the brain, baseline extent of tumor, and uptake changes over time useful in recognizing a differentiating pattern when compared with the initial planning scan. Also, utility of ^{18}F-DOPA PET scan may go beyond identification of necrosis in Radiation Oncology. It can reveal early metabolic uptake in irradiated area upon recurrence and identify potential re-treatment opportunities upon mapping of low-dose areas.

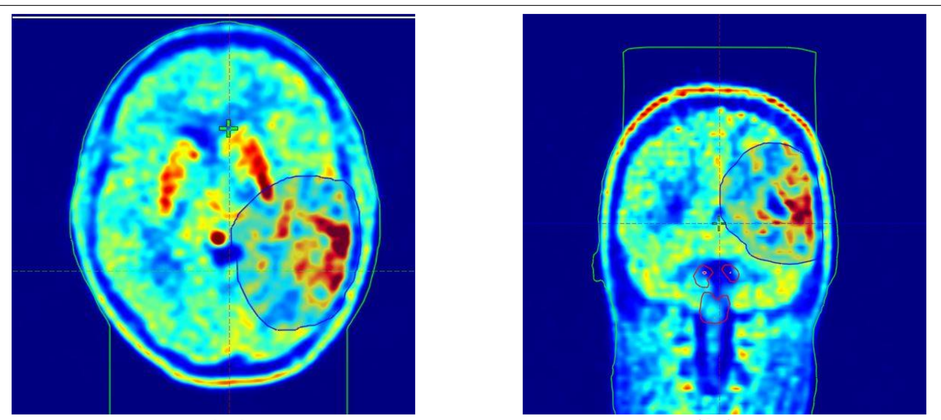
Discussion

•Existing data suggest that Positron emission tomography (PET) with 3,4-dihydroxy-6-[18F] fluoro-l-phenylalanine (18F-FDOPA) visualizes recurrent glioma that is not clearly identified on magnetic resonance imaging (MRI).

•In this study we found that F-FDOPA PET MRI clearly identified true progression from treatment related changes in glioblastoma patients treated with concurrent chemoradiation.

•This study supports target volume delineation of recurrent disease based on the fused FDOPA PET MRI images on planning CT.

•^{18}F-DOPA PET MRI PET scan has the significant utility of not just indicating necrosis from prior radiotherapy, but identifying early tumor progression, its location and opportunity for re-treatment based on the mapped dosimetry.



(a) (b)

Figure 2: ^{18}F-DOPA PET MRI scan images sowing recurrent GBM tumor inside the high dose treated volume.(a) axial (b) coronal

Conclusion

^{18}F-DOPA PET scan has significant utility for future CNS practice in Radiation Oncology, indicating not just necrosis from prior radiotherapy, but identifying early tumor progression, its location and opportunity for re-treatment based on the mapped dosimetry.

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