Registration number: 476

Title of the presentation: RETROSPECTIVE STUDY OF MAGNETIC RESONANCE IMAGING VS AMINO ACID PET IMAGING IN TREATED CASES OF GRADE III AND IV GLIOMAS

Authors and Institute:
CATEGORY: MISCELLANEOUS
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Introduction/ Review of Literature:

Conventional magnetic resonance imaging has limitations in differentiating tumor recurrence from radionecrosis in high-grade gliomas which can present with morphologically similar appearances. Multiparametric advanced MR sequences and Positron Emission Tomography (PET) with amino acid tracers can aid in diagnosing tumor metabolism.
The role of both modalities on an individual basis and combined performances were investigated in the current study.

Rachinger et al., compared FET-PET with MRI involving 46 patients; the sensitivity and specificity of FET-PET for the detection of recurrent tumors were 100% and 93%, respectively, compared with 93% and 50% for MRI

A recent systematic review and meta-analysis on the discriminators of pseudoprogression and true progression in high-grade gliomas demonstrated that dynamic susceptibility contrast perfusion MRI (DSC-MRI) and DWI showed the highest diagnostic accuracy .

Aims/ Objectives:

This study compares imaging features of MRI with amino acid PET tracer O-(2-[18F] fluoroethyl-L-tyrosine (FET) to differentiate tumor recurrence from radionecrosis in high-grade gliomas.

Methodology:

Patient selection:

Inclusion criteria:

- Patients with histologically proven higher grade gliomas(III, IV-both astrocytomas and oligodendrogliomas) who underwent treatment
- MRI and amino acid imaging available within 3 weeks of each other without any oncologic treatment or neurosurgical intervention

Exclusion criteria:

Patients with lower grade glioma, brainstem gliomas, non-glial tumor on histology

- Incomplete imaging studies,
- Gap of more than three weeks between two imaging modalities (MRI and FET)

Instrumentation:

MRI

1.5 Tesla, Philips Ingenia (Amsterdam, Netherlands

Axial FLAIR sequence, T2-weighted turbo spin-echo sequence, DWI and PWI/perfusion EPI

The protocols for the perfusion measurements were adapted to the scanner performance.

FET PET

Patients were injected with 5–6 mCi (185–222 GBq) of F-18-FET on the day of imaging

Dedicated static imaging of the brain was performed at 20 min post-injection using a Philips Gemini TF TOF-64 PET/CT scanner

A plain and post-contrast CT scan of the brain was performed in the craniocaudal direction
PET scanning was performed immediately after CT acquisition without changing the patient's position on the scanning table.

Image Interpretation:

ROI over the area corresponding to the suspicious area on MRI and another ROI over contralateral white matter. Based on prior studies, an optimum T/Wm cutoff of 2.65 was used (32).

MRI: High-resolution GE multisync LCD monitor with 5 and or 12 MP resolution neuroradiologists

ROI were placed on areas showing T2 intermediate signal which showed solid enhancement.

FET PET: all reconstructed images were viewed on a display system having extended brilliance workspace software (EBW) version 4.5.3.40140, Philips Healthcare

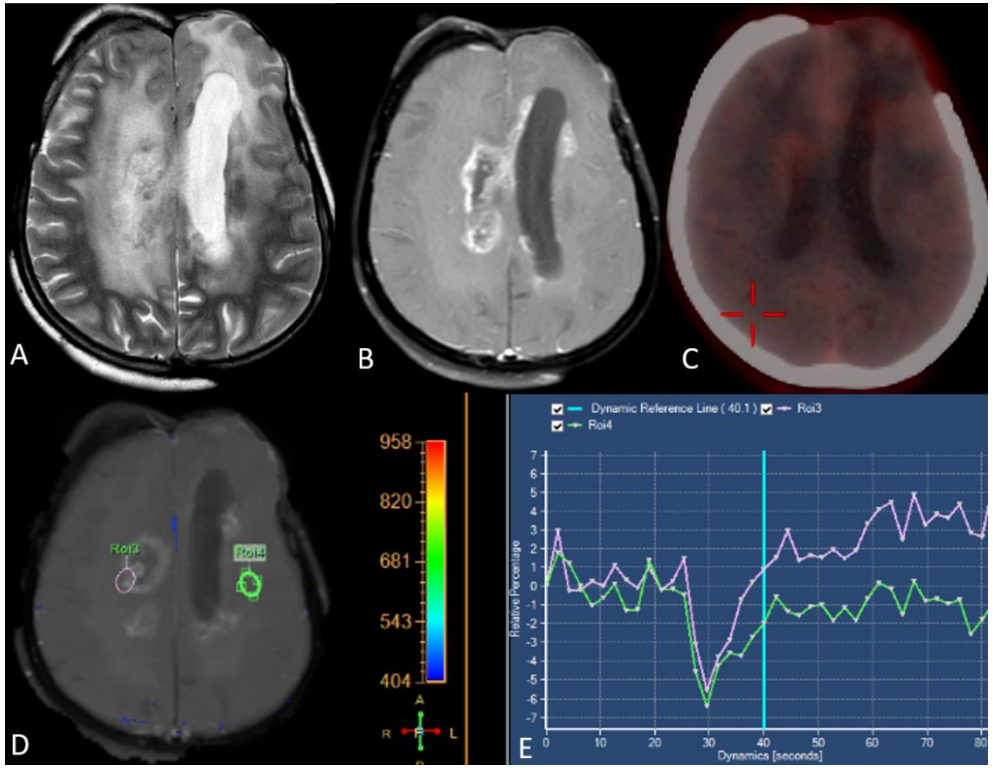
An independent nuclear medicine physician analyzed the images,

An equally sized ROI was placed in the contralateral, normal-appearing brain tissue for calculation of the maximum rCBV (rCBVmax = CBVtumor /CBVnormal tissue).

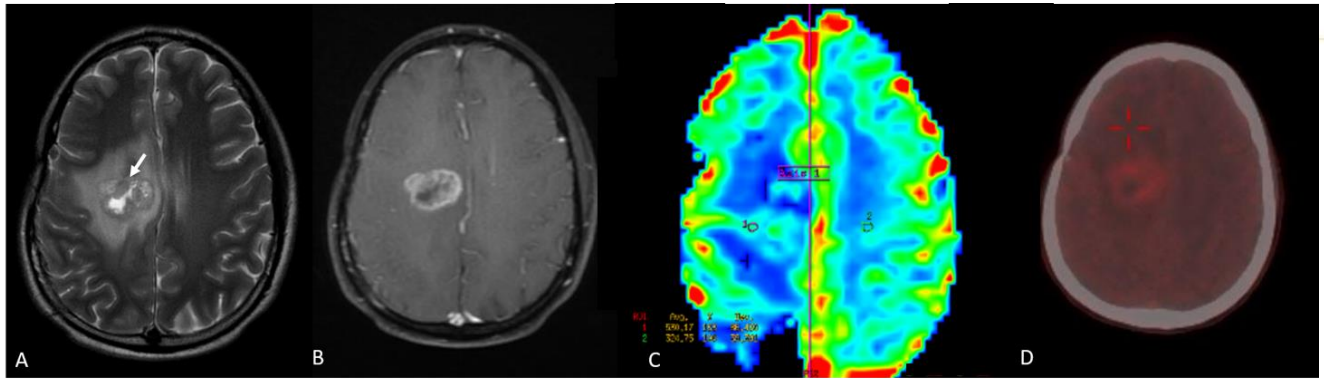
Results: In the study, 62 patients were included between July 2018 and August 2021

Study	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
MRI	98.08%	76.92%	94.44%	90.91%	93.85%
FET PET CT	78.85%	84.62%	95.35%	50%	80%
Combined Studies	97.96%	100%	100%	91.67%	98.33%

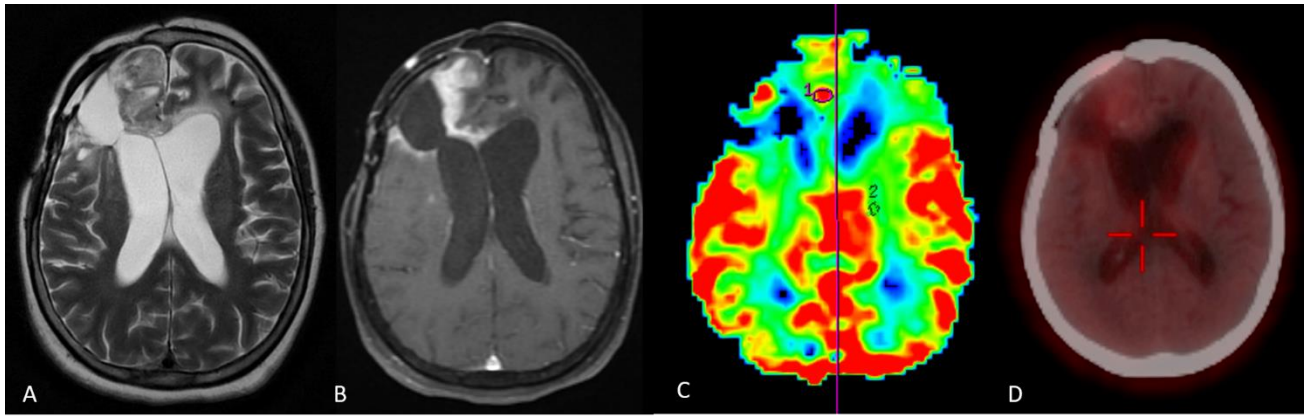
Representative images:



Axial T2-weighted (A), T1 + Gd (B), perfusion curve (D,E) and FET-PET (C) images in a case of grade III oligodendroglioma shows T2 hyperintense areas in the right centrum semiovale with surrounding edema. This lesion shows a “Swiss-cheese” pattern of enhancement (B) and hypoperfusion (D). FET-PET (C) shows no significant uptake (T/W ratio: 1.6) in the same area. These features were suggestive of radionecrosis.



Axial T2-weighted (**A**), T1 + Gd (**B**), perfusion map (**C**) and FET-PET (**D**) images in a case of glioblastoma shows T2 intermediate areas (arrow) in the right parasagittal location with surrounding edema. Thick peripheral rim of enhancement (**B**) and hyperperfusion (**C**) is seen, with ROI1 placed in the perilesional area and ROI2 placed in normal white matter, separated by the demarcation labelled Axis 1. FET-PET (**D**) shows no significant uptake in the same area (T/W ratio: 1.9). This was a case of tumor recurrence, with false negative results on FET-PET.



Axial T2-weighted (**A**), T1 + Gd (**B**), perfusion map (**C**) and FET-PET (**D**) images in a case of glioblastoma shows T2 intermediate areas (arrow) in the right frontal lobe. Thick peripheral enhancement (**B**) and hyperperfusion (**C**) is seen in ROI1 placed in the enhancing component and ROI2 in the normal white matter. FET-PET (**D**) shows no significant uptake (T/W ratio: 2.2) in the same area. This was a case of radionecrosis, with false positive results on MRI.

Conclusion:

1. Our findings support the use of MRI and [18F]FET PET in combination to distinguish radiation necrosis from recurrence in gliomas with excellent accuracy.

2. To improve clinical decision-making, we propose a stepwise approach as a resource-saving and cost-effective strategy with regular MRI-based surveillance and using FET-PET in conjunction for patients with equivocal MRI findings.

References

- Sahu A, Mathew R, Ashtekar R, Dasgupta A, Puranik A, Mahajan A, Janu A, Choudhari A, Desai S, Patnam NG, Chatterjee A. The complementary role of MRI and FET PET in high grade gliomas to differentiate recurrence from radionecrosis. Frontiers in Nuclear Medicine. 2023 Apr 27;3:1040998.
- Filss CP, Cicone F, Shah NJ, Galldiks N, Langen KJ. Amino acid PET and MR perfusion imaging in brain tumours. Clinical and translational imaging. 2017 Jun 1;5(3):209-23.
- Galldiks N, Law I, Pope WB, Arbizu J, Langen KJ. The use of amino acid PET and conventional MRI for monitoring of brain tumor therapy. NeuroImage: Clinical. 2017 Jan 1;13:386-94. Shah R, Vattoth S, Jacob R, Manzil FF, O'Malley JP, Borghei P, Patel BN, Curé JK. Radiation necrosis in the brain: imaging features and differentiation from tumor recurrence. Radiographics. 2012 Aug 31;32(5):1343-59.
- Sanghvi D. Post-treatment imaging of high-grade gliomas. The Indian journal of radiology & imaging. 2015 Apr;25(2):102.
- Mullins ME, Barest GD, Schaefer PW, Hochberg FH, Gonzalez RG, Lev MH. Radiation necrosis versus glioma recurrence: conventional MR imaging clues to diagnosis. American Journal of Neuroradiology. 2005 Sep 1;26(8):1967-72.
- Alonso RC, de la Peña MJ, Rodriguez MR, Arranz JC, de Vega VM, Moreno JP. Magnetic Resonance Imaging Findings of Radiation-induced Changes After Treatment of Malignant Gliomas and Metastases with a Particular Emphasis on Radiation Necrosis. Magnetic Resonance Imaging Findings of Radiation-induced Changes After Treatment of Malignant Gliomas and Metastases with a Particular Emphasis on Radiation Necrosis. 2011.