J of Nuclear Medicine Technology, first published online November 20, 2020 as doi:10.2967/jnmt.120.252866

^{18}F-FDG PET imaging predicts the epileptogenic zone prospectively in recurrent cryptogenic meningoencephalitis and with subsequent simple partial visual seizures

Short Running Title: ^{18}F-FDG PET in encephalitis and seizures

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The author has no conflict of interest

The author has no financial disclosure

IRB waiver as per institutional policy

Abstract

^{18}F-FDG PET scans have proven to be useful in the diagnosis and management of encephalitis patients. ^{18}F-FDG PET scans are also standard of care in the evaluation of the pre-surgical epilepsy patient. Encephalitis patients that later on develop epilepsy may have useful imaging findings at the time of diagnosis. We present a case of ^{18}F-FDG PET imaging in a patient with recurrent cryptogenic meningoencephalitis. ^{18}F-FDG PET imaging after resolution of the encephalitis revealed hypometabolism in previous hypermetabolic areas. Hence, the initial FDG PET scan prospectively predicted the epileptogenic zone/seizure onset zone (EZ/SOZ).

Key Words: meningoencephalitis; FDG; PET; epileptogenic zone; EZ, seizures, epilepsy, seizure onset zone, SOZ.

INTRODUCTION

This case considers the utility of FDG PET in characterizing acute encephalitis and describes findings predictive of the development of seizures.

CASE

We present a woman with recurrent cryptogenic biopsy proven meningoencephalitis starting at 40 years old, who later on developed simple partial visual seizures. ^{18}F-FDG PET scans were performed for evaluation of the encephalitis and of subsequent medically intractable seizures –developed within 6 months post encephalitis- in the interictal and ictal phases. These scans were performed within 12 months from each other. Scans were analyzed and compared to a normal database and Z scores generated using Neuro-MIM software. During the episode of meningoencephalitis, intense hypermetabolism is noted in the left temporo-occipital, and hypometabolism in the left temporo- parietal regions (Figure 1A). There was also increased ^{18}F-FDG uptake in the limbic structures. ^{18}F-FDG PET imaging 2 months after the initial encephalitis revealed hypometabolism in the left temporo-occipital region with persistent hypermetabolism in the limbic structures (Figure 1B). After the clinical development of seizures, interictal and ictal imaging delineated areas of hypometabolism in the left temporo-occipital region (Figure 2C, 2D). Hypometabolism noted on the ictal PET scan was less compared to the interictal scan. Subtraction imaging demonstrated a relative increase of ^{18}F-FDG uptake ictally when compared to the interictal scan (Figure 3E, 3F). The SOZ was in the left occipital region similar to the hypermetabolic area noted during the initial encephalitis episode (Figure 1A).

DISCUSSION:

Encephalitis is a relatively rare condition for which making an accurate diagnosis can be

challenging. Clinical features are not specific and MRI can be normal in a considerable number of cases (*1,2*). Early diagnosis is important as many forms of treatment are effective if started promptly. FDG PET has been used successfully in MRI negative/inconclusive cases of encephalitis (*2-5*). It frequently manifests as hypometabolism but focal cortical hypermetabolism can also be observed (*2-5*). ^{18}F-FDG-PET imaging also shows, in a relevant number of patients, extra-limbic metabolic abnormalities (mainly in the brainstem, cerebellum, or cerebral cortex) (1. These PET findings are associated with clinical symptoms and active disease status more strongly than the MRI findings. FDG-PET has the potential to improve estimation of disease severity in patients with autoimmune encephalitis, with implications for follow-up evaluation and therapy monitoring.

On the other hand ^{18}F-FDG PET is also used to delineate (EZ/SOZ) in medically refractory epilepsy patients. Traditionally once seizures have occurred for a certain period of time, ^{18}F-FDG PET scans can help determine the surgical eligibility of a patient. However, in our case we demonstrated how ^{18}F-FDG PET predicted prospectively the SOZ as an area of hypometabolism in the previous hypermetabolic area of the initial encephalitis. This finding was noted prior to the patient developing seizures. SOZ hypometabolism worsened with time following clinical seizures development. Considering all findings on an ^{18}F-FDG PET scan during the encephalitis episode and the recovery period may help in clinical management and close monitoring of these patients. Patients that have cortical hypermetabolism that converts to hypometabolism and does not normalize may be at a higher risk of developing intractable seizures later on. This can help in guiding new treatment approaches. However this needs to be further explored and validated in a larger cohort of encephalitis patients undergoing ^{18}F-FDG PET scans.

CONCLUSIONS

^{18}F-FDG PET scans performed in encephalitis patients may be able to help in the management of medically refractory epilepsy patients by prospectively predicting the seizure onset zone.

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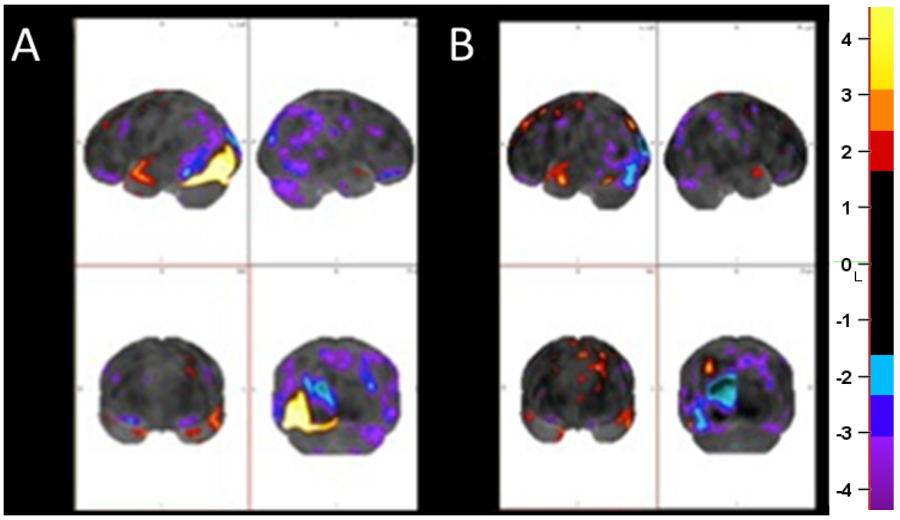

Figure 1. ^{18}F-FDG PET Metabolic Z Score Cortical Surface Map Projections Compared to Healthy Controls

A) Encephalitis episode

B) 2 months post-encepahilitis

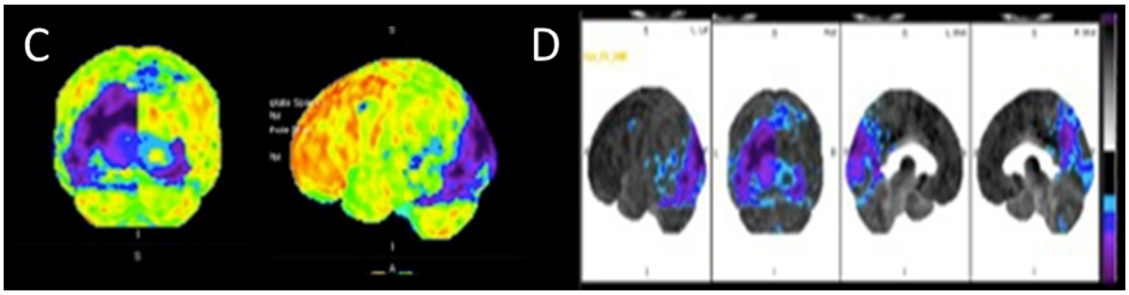

Figure 2. ^{18}F-FDG PET for Epilepsy C) SSP (stereotactic surface projection) Inter-Ictal scan

D) Inter-Ictal Z score Cortical Surface Map Projections Compared to Healthy Controls

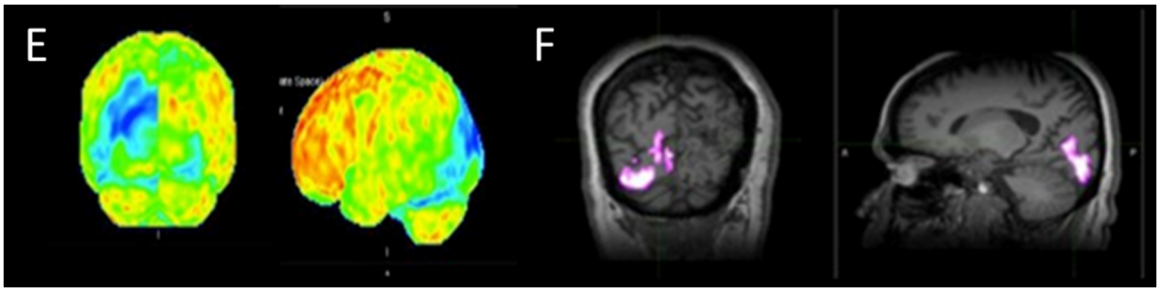

Figure 3. ^{18}F-FDG PET for Epilepsy E) SSP (stereotactic surface projection) Ictal scan

F) Subtraction Ictal-Interictal showing a significant cluster for the SOZ in the left occipital lobe

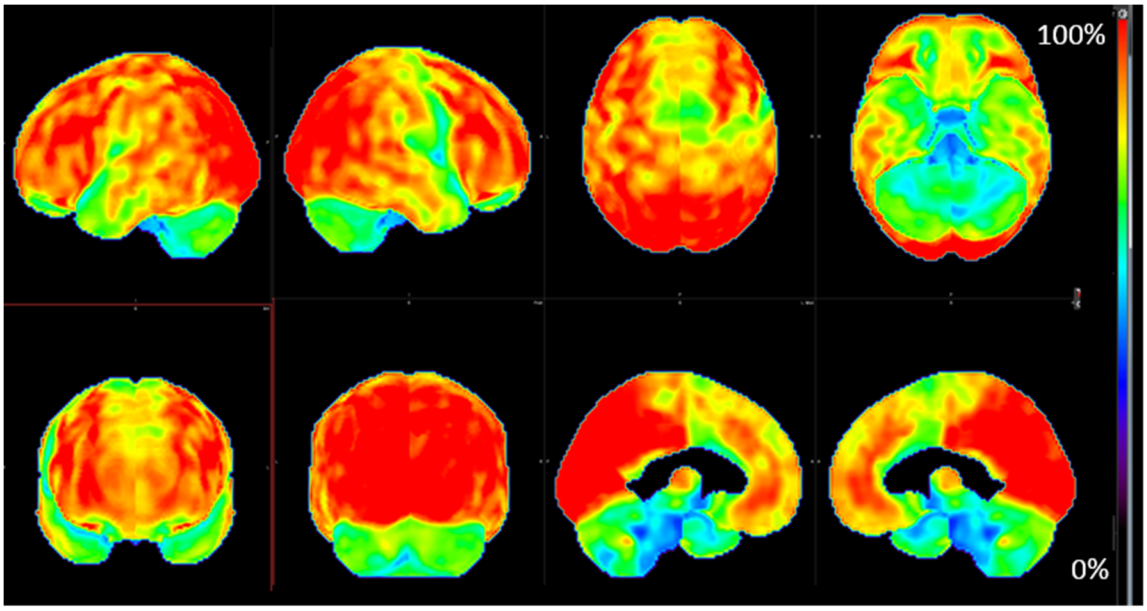

Figure 4. Healthy Control SSP Comparison