Clinical note

Early detection of encephalitis with 18F-FDG PET/CT

M.C. Gaeta a,*, M. Godani b, R. Nunziata c, C. Capellini d, A. Ciarmiello a

a Nuclear Medicine Department, S. Andrea Hospital, La Spezia, Italy
b Neurology Department, S. Andrea Hospital, La Spezia, Italy
c Neuropathology and Neurology S, IRCCS Foundation “Carlo Besta” Neurological Institute, Milano, Italy
d Neuroradiology Unit, S. Andrea Hospital, La Spezia, Italy

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ABSTRACT

Encephalitis is a relatively rare condition for which making an accurate diagnosis can be challenging. In fact, clinical features are not specific and structural imaging can be normal in a considerable number of cases. However, an early diagnosis is important as many forms of treatment are effective if started promptly. Even though recent guidelines do not recommend 18F-FDG PET/CT for patients with suspected encephalitis, the case presented suggests that 18F-FDG PET/CT may play a relevant role for the early diagnosis of this clinical condition.

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Deteción precoz de encefalitis con 18F-FDG PET/TC

RESUMEN

La encefalitis es una enfermedad relativamente rara para la cual hacer un diagnóstico preciso puede ser un reto. De hecho, las características clínicas de la encefalitis no son específicas y las imágenes estructurales pueden ser normales en un número considerable de casos. Sin embargo, un diagnóstico precoz es importante ya que el tratamiento de muchas formas es eficaz si se inicia sin demora. Aunque recientes guías de práctica clínica no recomiendan 18F-FDG PET/TC para los pacientes con sospecha de encefalitis, este caso sugiere que 18F-FDG PET/TC puede jugar un papel relevante para el diagnóstico precoz de tal condición clínica.

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Introduction

Encephalitis is a relatively rare condition defined by the presence of an inflammatory process of the brain in association with neurologic dysfunction. Encephalitis can be caused by infectious pathogens or by post-immunization processes. Non-infectious diseases of central nervous system, such as vasculitis or paraneoplastic syndromes, can have similar clinical presentation and should be considered in the differential diagnosis. Among the infectious pathogens reported to cause encephalitis, the most common are viruses. An early diagnosis of viral encephalitis is important considering that for many forms treatment and supportive therapies are effective if started promptly. However, an accurate diagnosis can be challenging. In fact, clinical features are not specific, ranging from fever and headache to an altered level of consciousness and focal neurologic signs. According to the most recent guidelines, an appropriate diagnostic evaluation for patients with suspected encephalitis includes neuroimaging, with MRI being the procedure of choice. Nevertheless, in a considerable number of cases MRI findings can be normal at the clinical onset of symptoms or even during the course of the illness. Thus, a negative MRI does not rule out encephalitis.

This case report shows the potential role of 18F-FDG PET/CT for the early diagnosis of encephalitis, when conventional structural imaging with CT and MRI is normal or only faintly altered.

Case report

A 43-year-old woman presented with myoclonic jerks of the left leg that subsequently involved the other limbs.

At the time of the hospital admission the patient underwent a CT scan that did not show any alteration. A lumbar puncture was promptly performed and the cerebral spinal fluid examination was normal. The electroencephalography (EEG) showed diffuse slow waves without any epileptic discharges.

The first MRI including T1-weighted with and without contrast (Fig. 1C), T2-weighted, T2 fluid attenuated inversion recovery (FLAIR) (Fig. 1B), and diffusion weighted imaging (DWI) (Fig. 1A), showed only a faint contrast enhancement of the left posterior capsule. The second MRI performed 18 days after the first one showed the same finding.

* Corresponding author.
E-mail address: mc.gaeta@gmail.com (M.C. Gaeta).

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On the day after the second MRI, the patient underwent PET/CT (Figs. 1D and 2) 45 min after the administration of 316 MBq of $^{18}\text{F}$-FDG. Scan was obtained over 15 min using a 3D mode. $^{18}\text{F}$-FDG PET/CT showed focal areas of hypermetabolism in the left frontal lobe, left insula as well as in both parietal convexities and left putamen, with maximum standardized uptake value (SU[V]max) 5-fold higher than normal cortex.

Clinical condition rapidly worsened with the development of a progressive disorder of consciousness to a deep coma. The patient was transferred to the intensive care unit and then to the neurosurgical unit where a cerebral biopsy of the left frontal cortex led to the diagnosis of measles virus encephalitis (Fig. 3). The diagnosis was confirmed on a post-mortem biopsy.

**Discussion**

This case report shows a case of measles encephalitis, which is a rare condition occurring early or several years after infection and causing acute or subacute forms of encephalitis. The clinical course of the disease is usually characterized by cognitive deterioration, behavioral changes and myoclonus, with a mortality rate of 10–20%. Several papers showed that focal unilateral hypoperfusion at cerebral blood flow single photon emission computed tomography (SPECT) is an indicator of severe inflammation of the brain tissue in acute encephalitis and predicts poor clinical outcome.\(^5\)

There is little data regarding $^{18}\text{F}$-FDG PET/CT for the assessment of patients with suspected encephalitis. To our knowledge, the literature is limited to case reports and small case series. In one of the largest retrospective studies, the role of $^{18}\text{F}$-FDG PET/CT in the diagnostic evaluation of encephalitis was assessed in 10 patients.\(^6\) Cortical hypermetabolism, associated with multifocal hypometabolism, was demonstrated in 5 out of 6 cases of encephalitis. In a recent publication, a patient with herpes simplex virus showed a wide area of cortical and subcortical hypometabolism associated with a focal area of hypermetabolism, that in large part corresponded with signal alterations at the MRI of the brain.\(^7\)

Accordingly to the previous literature, we observed focal areas of hypermetabolism that may be related to the cerebral inflammatory process caused by the measles virus. Noteworthy, our patient did not demonstrate any seizure activity on the EEG, another possible cause of increased cortical FDG uptake.

The special interest for our case relies on the fact that $^{18}\text{F}$-FDG PET/CT outperformed MRI that showed only a faint contrast enhancement of the left posterior capsule, interpreted by the neuroradiologist as a possible vascular malformation.

This case suggests that $^{18}\text{F}$-FDG PET/CT may have an important role for the early diagnosis of viral encephalitis in a comprehensive evaluation of the patients including clinical assessment and structural imaging.
**Fig. 2.** Series of (A) transaxial and (B) coronal 18F-FDG PET images in which the relationship between hypermetabolic and normometabolic brain regions is clearly visualized.

**Fig. 3.** Biopsy of the left frontal cortex. (A) Eosinophilic, amorphous inclusions are present both in the nucleus and in the cytoplasm of a neuron. (B) Clusters of lymphocytes (CD-45 positive) are detected in the cortical neuropil.

**References**