Clinical note

**11C-Methionine uptake in secondary brain epilepsy**

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**A R T I C L E  I N F O**

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**ABSTRACT**

Carbon-11 methionine (\(^1\)\(^1\)C-Methionine) is a radio-labeled amino acid currently utilized in Positron Emission Tomography (PET) for imaging primary and metastatic brain tumors. Its clinical use relies mostly on oncologic applications, but the tracer has the potential to investigate other non-malignant conditions. So far, very limited evidence concerns the use of \(^1\)\(^1\)C-Methionine in patients suffering from seizure; however, the tracer can find a proper utilization in this setting especially as a diagnostic complement to 18\(^F\)-Fluorodeoxyglucose (18\(^F\)-FDG).

Herein we report the case of a 57-year-old patient presenting with epileptic crises secondary to a brain metastasis from bladder carcinoma, who was investigated in our institution with \(^1\)\(^1\)C-Methionine PET. The scan documented the disease recurrence in the left parietal lobe associated with a diffused tracer uptake in the surrounding cerebral circulations, derived from the comitial status. After surgical removal of the metastatic lesion, the patient experienced a complete recovery of symptoms and no further onset of secondary seizure.

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**Captación de la \(^1\)\(^1\)C-metionina en la epilepsia cerebral secundaria**

**R E S U M E N**

La \(^1\)\(^1\)C-metionina es un aminoácido radiomarcado que se utiliza actualmente en la tomografía por emisión de positrones (PET) para obtener imágenes de tumores cerebrales primarios y metastásicos. Su aplicación clínica más extendida es la oncología, pero tiene el potencial de investigar otras situaciones no oncológicas. Hasta el momento existe una limitada evidencia del uso de \(^1\)\(^1\)C-metionina en pacientes con crisis convulsivas; sin embargo, el radiotrazador puede tener utilidad en este campo especialmente como complemento diagnóstico de la 18\(^F\)-Fluorodeoxyglucosa (18\(^F\)-FDG). Presentamos el caso de un paciente de 57 años de edad con crisis epilepticas secundarias a metástasis cerebrales de un carcinoma de vejiga que fue explorado en nuestra institución con \(^1\)\(^1\)C-metionina PET. El estudio demostró la recidiva de la enfermedad en el lóbulo parietal izquierdo asociada con captación difusa en las circulaciones cerebrales de alrededor, derivada del status comicial. Después de la extirpación quirúrgica de la metástasis cerebral, el paciente experimentó una recuperación completa de los síntomas sin posterior inicio de crisis convulsivas secundarias.

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**Introduction**

The broadest evidence regarding the use of Positron Emission Tomography (PET) imaging in patients affected by seizure relies on 18\(^F\)-Fluorodeoxyglucose (18\(^F\)-FDG). Typically the pattern of 18\(^F\)-FDG distribution is characterized by reduced metabolism (hypometabolic area) at the level of the epileptogenic tissue when the tracer is administered during the interictal phase, or vice versa there is an elevated tracer uptake (hypermetabolic area) in the involved area when there is a prompt injection during the comitial crisis. The site and the precise definition of the pathologic areas directly influence the treatment options, but despite the overall good sensitivity of 18\(^F\)-FDG PET, localization of epileptic foci is not always possible and requires in most cases the use of additional software to overcome difficulties derived from pure visual analysis.

Carbon-11 methionine (\(^1\)\(^1\)C-Methionine) is a radio-labeled amino acid currently utilized in PET for imaging primary and metastatic brain tumors. Its clinical use relies mostly on oncologic applications, but the tracer has the potential to investigate other non-malignant conditions. So far, very limited evidence concerns the use of \(^1\)\(^1\)C-Methionine in patients suffering from seizure, however the tracer can find a proper utilization in this setting especially as a diagnostic complement to 18\(^F\)-Fluorodeoxyglucose (18\(^F\)-FDG).

We present the clinical case of a patient affected by brain metastasis associated with secondary seizure, which was correctly identified on \(^1\)\(^1\)C-Methionine PET.

**Case report**

The clinical case presented herein regards a 57-year-old female affected by a cerebral recurrence of bladder carcinoma localized...
in the left parietal lobe. The patient had already been treated with radio-ablation in March 2010, but 7 months later had experienced three generalized epileptic crises and had started complaining right-handed motor-sensitive deficit. The first therapeutic decision was to start anti-epileptic treatment with levetiracetam, in association with mannitol as antiedematous pharmaceutical support. After an apparent remission of clinical symptoms, 4 months later the patient had other two partial motor crises, which addressed her to our institution for the necessary instrumental investigations.

On that occasion the patient underwent cerebral contrast-enhanced CT (ceCT), according to standard procedure, and $^{11}$C-Methionine PET, in order to define disease status. For the PET scan she received 328 MBq (4.6 mCi/kg) of tracer and images were acquired 10 min later with a Siemens Biograph 6 LSO (10 min emission for 1 bed position, 256 × 256 matrix, zoom 2.0 and OSEM iterative algorithm; 80 mAs, 130 kV and 5 mm collimation 6 mm × 3 mm for the localization CT).

Instrumental data derived from both imaging modalities confirmed the presence of malignant tissue in the peripheral territories of the post-ablative cavity (rolandic region): the lesion presented as a contrast-enhanced area on CT and was characterized by a highly increased $^{11}$C-Methionine uptake on PET (Fig. 1: arrowheads). In addition to the malignant findings, the PET scan demonstrated some abnormal tracer uptake moderately diffused in the frontoparietal lobes, broadly outside the margins of the tumor site, interesting almost exclusively the cerebral circulations (Fig. 1: arrows). This additional pattern was interpreted as a functional alteration related to the underlying comitant status. The patient was consequently addressed to a selective surgical removal of the malignant lesion in the left rolandic region, which resulted in a complete remission of the epileptic crises.

Discussion

The first report documenting the use of $^{11}$C-Methionine in epileptic patients belongs to Madakasira et al., who in 2002 described the utility of the dual-tracer imaging ($^{18}$FDG and $^{11}$C-Methionine) in the same child affected by focal cortical dysplasia (FCD). In their report the authors describe a complementary pattern in the distribution of the two radiopharmaceuticals in the epileptic focus during the interictal phase, typically characterized by hypometabolism on $^{18}$F-FDG PET with on counterpart an increased uptake on $^{11}$C-Methionine PET. Something similar has been reported also in two other case reports, both investigating intractable seizure in children.

More recently, also Phi et al. have thoroughly investigated the role of $^{11}$C-Methionine in epileptic children when trying to differentiate FCD from neural and glial tumors as underlying etiopathology. Their findings documented a different uptake pattern for malignant lesions and FCD, with the later one associated to hypometabolism on $^{18}$F-FDG PET and mild-hypo to normal uptake on $^{11}$C-Methionine PET.

In our patient the underlying cause for seizure appears to be the tumor recurrence, whereas the epileptic alteration is documented as a mildly diffused uptake of $^{11}$C-Methionine in the cortical areas involved by the secondary seizure manifesting with functional deficit and motor crises. This setting is quite new and to our knowledge this is the first report of its kind in adults. Undoubtedly age and clinical setting must have somehow influenced differences in imaging findings and outcome data; anyhow our case study and all previous reports similarly suggest the potential benefit and application of $^{11}$C-Methionine PET in epileptic patients. This would be particularly relevant when selective ablation is advised and a precise contouring of the area involved in seizure must be given prior to surgery.

Further studies are therefore welcome in order to investigate the role of $^{11}$C-Methionine PET in this setting and assess its proper application in the management of patients affected by seizure.

References


