PET IN EPILEPSY: CLINICAL CASE PRESENTATION

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ABSTRACT:

Introduction: Epilepsy is a disorder of the central nervous system characterized by recurrent seizures unprovoked by an acute systemic or neurologic insult. According to the World Health Organization (WHO) this neurological disorder is affecting about 0.5-1.0% of the population of the World. New, modern radiological studies are of great importance in the diagnosis of pathogenesis and clinical manifestation of epilepsy. The PET / CT study in epileptic assays has never been performed in Lithuania.
This case demonstrates one of the first PET/CT scans of the brains in Lithuania for patient with epilepsy.
The aim: To report the case of epilepsy patient who undergone PET/CT scan of the brain before neurosurgical operation.
Case: Patient Z. B. is a 28-year-old female with a history of epileptic seizures since she was seven. Despite medical treatment she continued to have seizures and surgical treatment was recommended. Before the first surgery epileptogenic focus was evaluated using magnetic resonance imaging (MRI), electroencephalography (EEG) and clinical data. However, after the intervention she still experienced multiple seizures every day. Later she underwent positron emission tomography with 18F-fluorodeoxyglucose (18F-FDG PET) which showed that the lesion of the brain was bigger compared with lesion showed by MRI.
Outcome: After second surgery patient remained seizure free.
Conclusion: Our case demonstrates that 18F-FDG PET is a useful diagnostic tool to evaluate epileptogenic focus in patients with refractory epilepsy.

Keywords:* ^{18}*F-FDG PET, MRI, EEG, refractory epilepsy.

INTRODUCTION

Epilepsy is a group of neurological diseases characterized by epileptic seizures caused by the excessive electrical firing of a number of neurons. It is one of the most common neurological disease among people of all ages. The prevalence in the world and Lithuania ranges from 0.5 to 1% [1]. According to epidemiological data, more than 30% of the patients continue to have seizures despite medical treatment [2]. Surgical removal of the epileptogenic focus (EF) is an effective method of treatment for patients suffering from refractory epilepsy. Refractory epilepsy patients refers those diagnosed with epilepsy who, despite having undergone two appropriate selected therapy treatments with different antiepileptic drugs, do not manage to obtain seizure free period [3]. A randomized controlled trial by K. Fiest et all confirmed that surgical treatment is superior to prolonged medical treatment in refractory temporal lobe epilepsy [4]. For successful seizure control epilepsy surgery requires selection of the patients suitable for surgery and precise estimation of the EF [5]. Invasive electroencephalography (EEG) is gold standard for detection of the EF, but invasiveness of this approach requires careful patient selection. Magnetic resonance imaging (MRI) is required to exclude structural abnormalities that cause epilepsy: tumors, arteriovenous malformations etc. Brain positron emission tomography with fluorodeoxyglucose (18F-FDG PET) helps to identify the exact location of the epileptogenic focus. Studies, some of with consisted of large number of patients, have reported a sensitivity of 75-90% for temporal lobe epilepsy [6, 8]. The purpose of this case report was to describe one of the first brain 18F-FDG PET scans in Lithuania to identify the epileptogenic zone for the patient with drug resistant epilepsy before resective epilepsy surgery.

CASE REPORT

Patient Ž. B. is a 28-year-old woman who has a history of epileptic seizures since she was seven. Patient has a family history with her cousin suffering from epilepsy too. At the age of four she

presented at the hospital because of fever (39C°) and febrile seizures with an upward gaze, tonic-clonic seizures and fibrillations of the left part of the face. She was treated with diazepam, later on with phenobarbital and seizures stopped. In 1995 our patient experienced her first non-febrile seizure: seizure started with loss of consciousness, back muscle spasm and upward left eye gaze. In 1997 she was diagnosed with partial epilepsy with secondary generalization (cryptogenic partial epilepsy) and treated in the Department of Neurology at Vilnius University Hospital Santaros Klinikos. During the course of the disease patient has tried many antiepileptic medications including carbamazepine and sodium valproate, both in monotherapy and in combination, which failed to achieve seizure control. All antiepileptic drugs she tried failed to sustain seizures. In 2002 because of a drug resistant epilepsy she underwent presurgical evaluation at Lithuanian University of Health and Sciences hospital.

MRI IMAGING AND EEG

EEG demonstrated abnormalities in the right frontotemporal zone, a sleep EEG only registered information from the first two stages of the sleep. MRI showed a part of the right posterior middle frontal gyrus cortex that was thicker (Figure 1). The abnormalities found on EEG were matching the MRI findings (Figure 2).

FIRST SURGERY

Using MRI, EEG and clinical data it was decided to remove the abnormal brain cortex found on MRI. Surgery went without complications, unfortunately, patient had postoperative recurrent seizures 1-4 per night. After the surgery she continued treatment, but she still experienced multiple seizures every day (8-9 per day). In March 2012 she had a control MRI which showed a small abnormal cortex right mass in the same region (Figure 3) but re-operation was not recommended.

Figure 1. Abnormalities of the cortex in the right posterior middle frontal gyrus

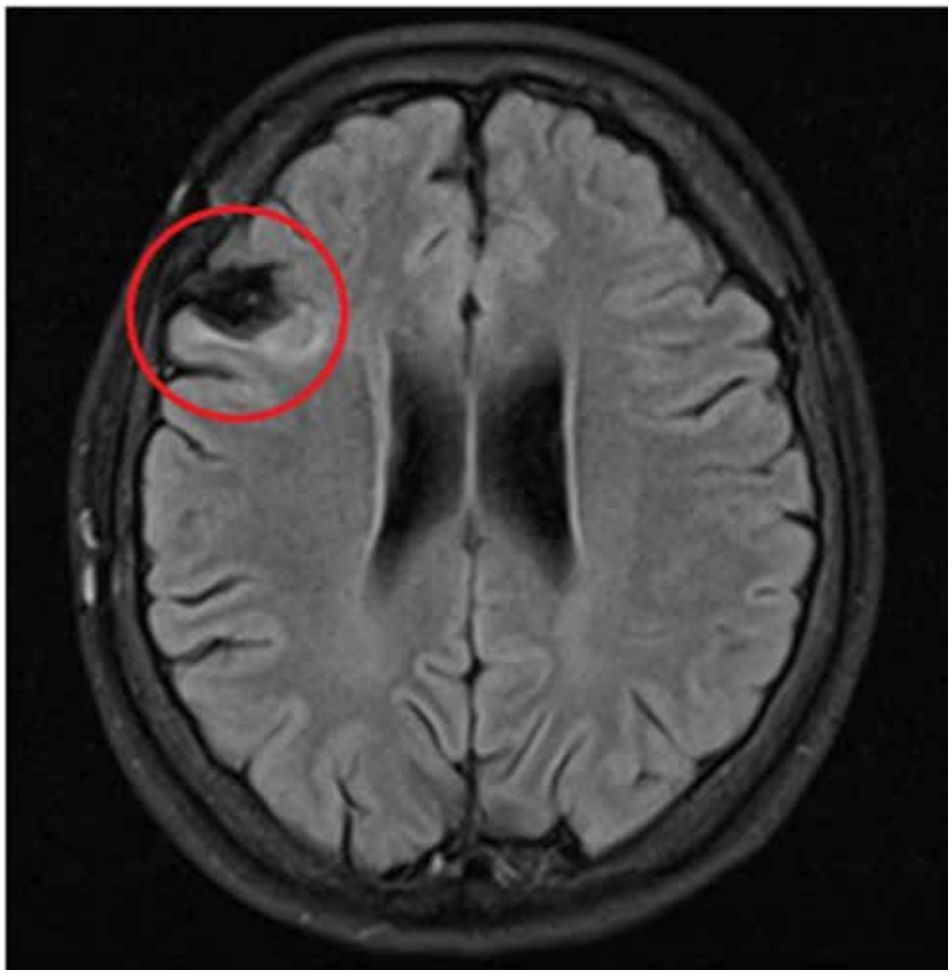


Figure 2. EEG findings demonstrating abnormalities in the right frontotemporal zone.

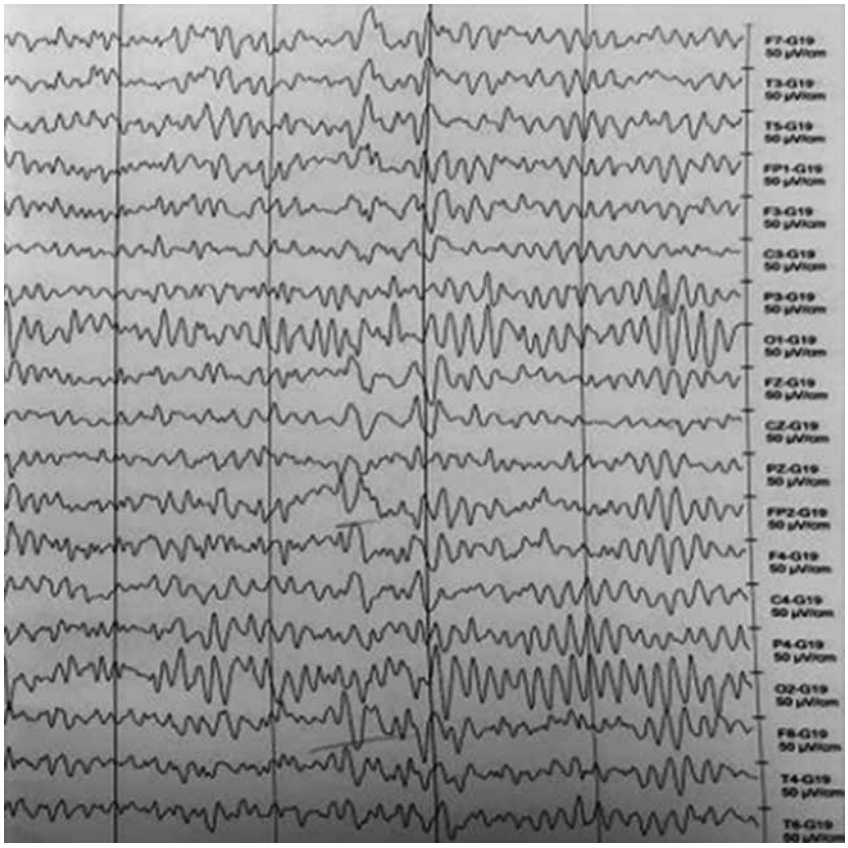


Figure 3. Small abnormal cortex mass in the right

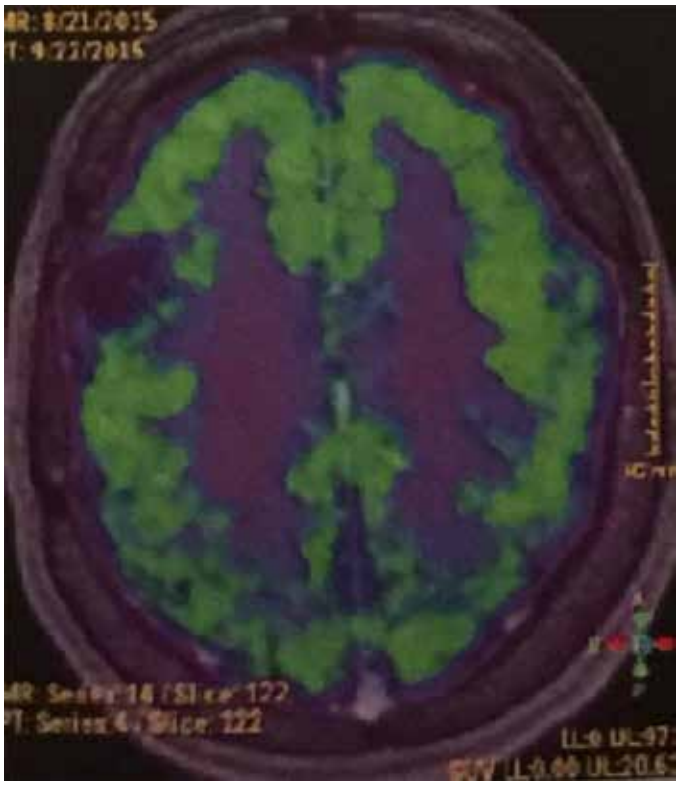
POSITRON EMISSION TOMOGRAPHY

Before the second surgery she underwent PET scan with 18F-FDG at Hospital of Lithuanian University of Health Sciences which showed hypometabolism in the right frontal region in the cross-section of the frontal and precentral sulcus with a hypoperfusion zone around this area (Figures 4, 5, 6). Compared with MRI taken before PET, the localization of the lesion was in the same place like on MRI scan, but the zone of hypoperfusion was bigger.

RESULTS

In 2015 she was considered for reoperation after the first failed resective epilepsy surgery. Patient has remained seizure free since the second surgery.

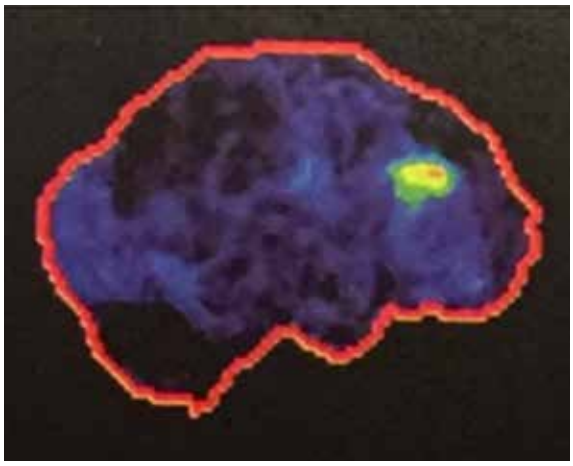
Figure 4. Hypometabolism with a hypoperfusion zone around in the right frontal region.

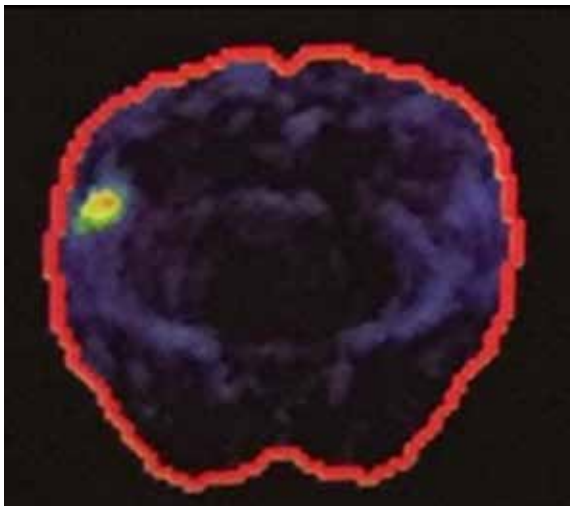


DISCUSSION

PET is widely available noninvasive technique in the world that plays an important role in the presurgical evaluation of patients with medical resistant refractory epilepsy. It can help to make

Figures 5, 6. Sagittal and frontal views.





decision in over 50% of patients with both positive and negative MRI findings before the intervention [7]. To our knowledge so far, only few patients with refractory epilepsy were examined using 18F-FDG PET in Lithuania. The use of this technique is was limited by the lack of indications for brain PET scans and a high cost. PET is valuable technique with high sensitivity especially for evaluating people with temporal lobe epilepsy (TLE). It can localize EF with up to 90% sensitivity for TLE and for extratemporal epilepsy (extra-TLE) up to 55% [8;9]. In this case 18F-FDG PET was applied because it can provide important information in ad-

dition to MRI as first surgery based on MRI results wasn't successful. Studies showed that PET co-registration with MRI improves detection of the lesion and surgical success [10]. There are several advantages of PET/MRI co-registration. First, it provides improvement in EF localization with requiring little additional time and workload, furthermore, hybrid system minimizes patient discomfort while improving the detection of EF. Finally, when examining pediatric patients in comparison to PET/CT, the effective dose is reduced [11]. Recent study shows that statistical parametric mapping may improve the sensitivity of ^{18}F-FDG PET in cases where visual assessment is negative [12]. Some non-FDG brain PET studies such as 11C-flumazenil (FMZ) PET are thought to be more sensitive and accurate than FDG-PET in the detection of EF in patients both with TLE and extra-TLE epilepsy [13] but their use in clinical practice is limited because they usually have short half-life and require cyclotron on-site [14]. PET is superior method in lateralization of the EF comparing it with ictal SPECT, other imaging modality used for EF localisation, although they are both more sensitive than MRI. Multimodality approach (use of MRI, PET and ictal SPECT) together is especially beneficial in cases of negative MR findings[15].

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