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Case Report

Positron Emission Tomography (PET Scan) in Neuronavigation-Guided Biopsy of Complex Brain Tumors

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Abstract

Male patient, 38 years old, with a history of previous surgical intervention in another center for brain lesion in the left fronto-parietal region, who had undergone a biopsy, with a result of failed pathological anatomy (he had no diagnosis). In the neurological examination, the patient was conscious, oriented in the three spheres, without neurological deficit, Glasgow 15/15. In the cranial MRI was observed in the left fronto-parietal subcortical region a hypointense lesion on T1, and an irregular hyperintense image in relation to the midline on T2, which did not uptake the contrast medium. Surgical intervention was performed, with a biopsy guided by the neuronavigation system (Brain Lab Curve) using a trephine less than 1 cm and the target planned by fusion of PET scan choline (Positron Emission Tomography) and contrasted cranial MRI, the most representative sample of the lesion was taken where observed the maximum affinity of the lesion for radioactive choline. The Pathological Anatomy result was low grade Astrocytoma, establishing a diagnosis. Control cranial CT scan 6 hours post-operatively, which determined the planned biopsy sample site. The post-surgical evolution was satisfactory, Glasgow 15/15, without neurological deficit. It has been proposed to continue treatment for these cases. In cases of complex lesions where CT and MRI cannot offer adequate resolution through imaging of the lesion, PET scan choline can offer an option to plan an appropriate biopsy of the lesion and obtain representativeness and obtain the best diagnosis. We recommend the use of PET scan in these cases.

***Keywords:** Brain tumor; Gliomas, PET scan; Neuronavigation; Biopsy.*

Introduction

In brain tumors, several modalities of diagnostic imaging procedures are currently available, including: MRI, CT and ultrasound. Although cranial CT allows a quick and accessible diagnosis of tumor, in defining the volume and specifying whether it is tumor, edema or necrosis, the image resolution it can offer is very limited. In the case of cranial MRI sequence that could offer better definition T2 sequence spectroscopy with contrast, but may underestimate the metabolically active tumor volume (1,2,3). The real usefulness of ultrasound is defined intraoperatively to establish that no residual tumor is found in accessible and recommended cases of total surgical excision. In the present case the most important approach is to obtain a representative biopsy of the lesion with help of the best imaging procedure.

In cases in which localized lesions (deep subcortical lesions and in eloquent areas) the direct surgical approach could represent a high risk of adding important neurological deficits and total resection could be limited. In these cases, it is necessary, when it is decided to perform biopsies of brain tumors by neuronavigation, to delimit with the greatest possible certainty the actual volume of the lesion to extract the best representative sample for pathological diagnosis and offer the best complementary treatment option available. In these cases, routine studies obtained through MRI or CT (2,3,4) have specific limitations in this task. However, the brain PET scan plays a decisive role since it can offer better representative images of the lesion and take the best sample through.

Clinical Case

Male patient, 38 years old, with a history of previous surgical intervention in another center for brain lesion in the left fronto-parietal region, who had undergone a biopsy, with a result of failed pathological anatomy (he had no diagnosis). In the neurological examination he was conscious, oriented in the three spheres, without neurological deficit, Glasgow 15/15. The patient had clinical seizures, several episodes despite treatment with a double anticonvulsant regimen.

Complementary Exams

Cranial MRI was performed, in T1 with contrast, in axial, coronal and sagittal sections, an image of an irregular hypointense lesion is observed in the left fronto-parietal region very close to the midline and without contrast medium uptake. In T2 sequence, an irregular, diffuse hyperintense image is observed, which does not uptake the contrast medium (Figure 1). The PET scan showed a metabolically active lesion in relation to the left sagittal fronto-parietal region. This lesion had approximate delimitation of its margins (Figure 2-3).

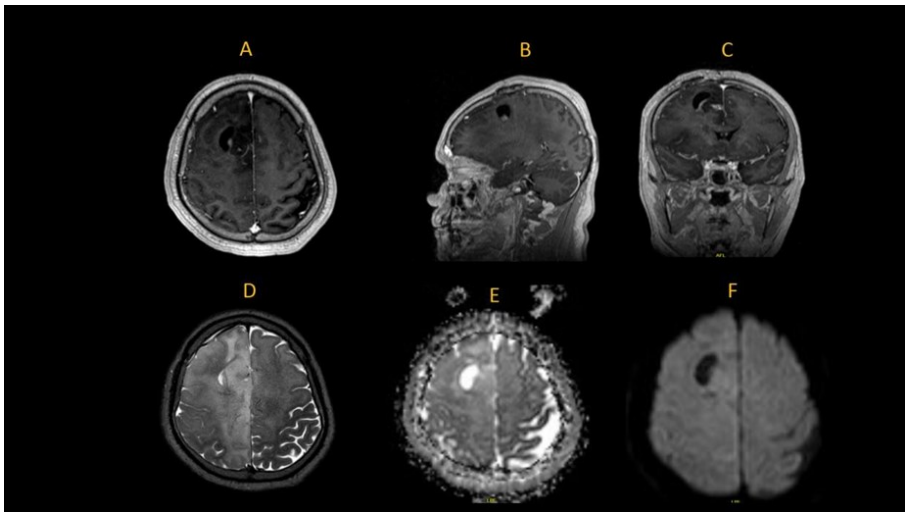

Figure 1: *Contrasted cranial MRI in T1 sequences in axial (A), sagittal (B), and coronal (C) sections that does not capture the medium contrast homogeneously. In different axial T2 (D, E, F) sections is observed an image of a diffuse, unlimited, infiltrative lesion in the right frontal region in relation to the midline. This image is limiting for taking the best biopsy sample.*

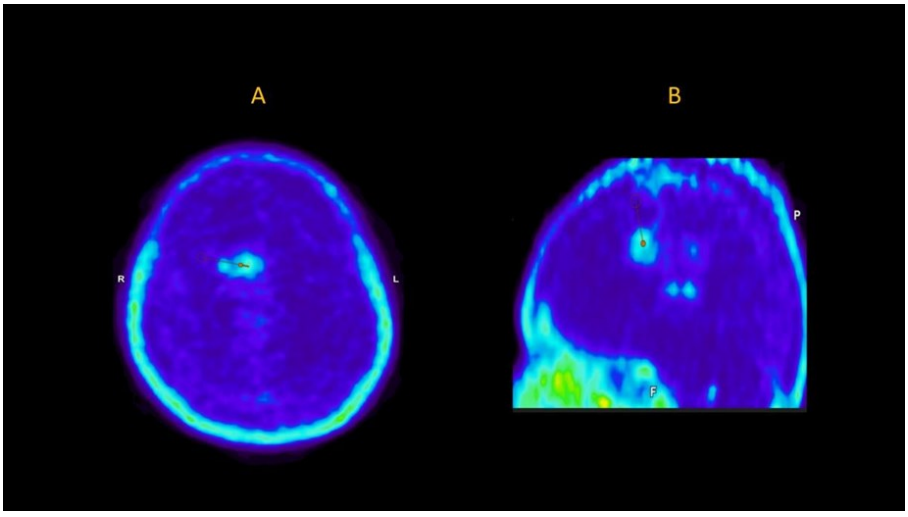

Figure 2: *Pet Scan with choline in axial (A) and sagittal (B) sections, a lesion is observed in the right frontal region in relation to the midline and is metabolically active. This lesion is metabolically active, delimited. Consequently, the PET scan will allow us to take a representative sample of the lesion and offer the best anatomo-pathological diagnosis.*

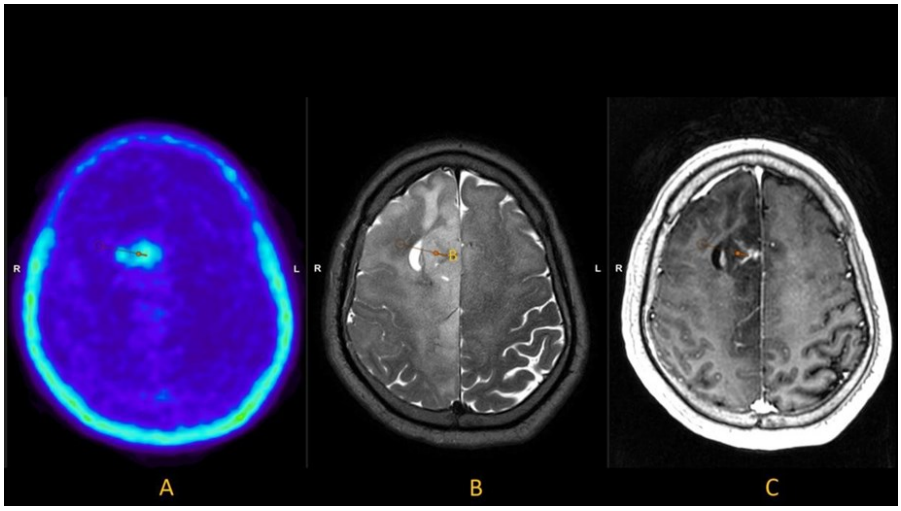

Figure 3: *PET scan study with choline (A) shows well-defined metabolically active lesion. Cranial MRI in T2 (B) and T1 (C) sequence shows diffuse lesion, without defined limits, which would make it difficult to take the best representative sample for a certain anatomo-pathological diagnosis.*

Surgery

Surgical intervention was performed with a biopsy through a burr hole of less than 1 cm (Figure 4) and guided by a neuronavigation system. The target was determined to obtain the most representative sample of the lesion. In post-operative a control cranial CT scan was performed in 6 hours, which was observed the site of the planned biopsy sample that reconfirmed with the presence of pneumocephalus, what has been described in previous publications (7,8) and there were no other significant alterations. The Pathological Anatomy result was Low Grade Astrocytoma. The clinical evolution was satisfactory, Glasgow 15/15, without neurological deficit. The patient was proposed to continue oncological treatment for these cases.

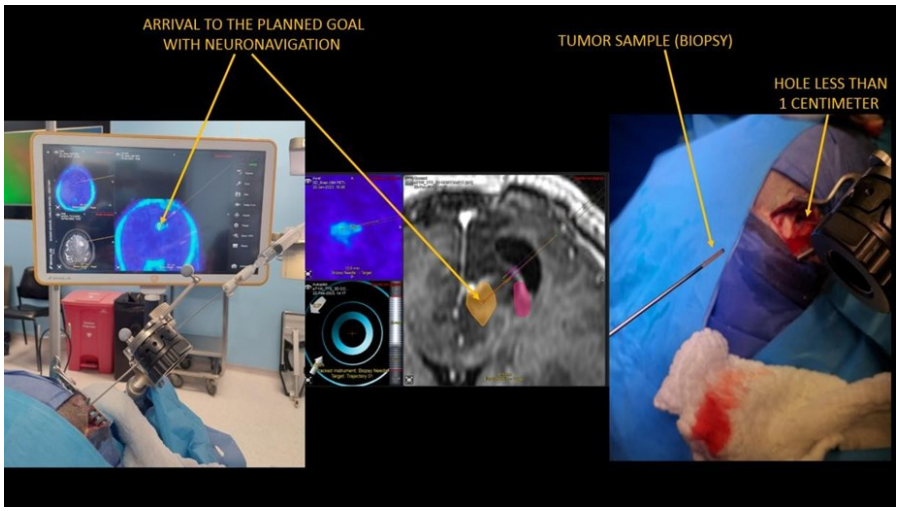

Figure 4: *The implementation of the procedure with neuronavigation is observed to reach the previously planned objective and obtain the biopsy.*

Discussion

Brain tumors are a real challenge to the Neurosurgeons when exeresis is attempted by direct approach due to their location, inaccessibility, the risk involved in a direct approach and the possibility of generating a neurological deficit in an intact patient. In a patient who has previously undergone surgery with failed pathological anatomy and the diagnosis is imperative to know the pathology diagnosis to offer the best possible treatment. In these cases, a good option is to offer a biopsy of the lesion for the previously indicated purpose.

Imaging examinations are a mainstay to obtain diagnosis. However, for certain lesions there are limitations with conventional imaging methods such as CT and MRI due to the nature. In these cases, PET scan offers better image resolution by establishing where the tumoral lesion is located metabolically and with greater activity (4,5,6,7,8,9). This can allow to take a representative sample of the lesion and definitively establish the diagnosis, like in this case.

The Positron Emission Tomography (PET SCAN) is a procedure that allows both structural and functional images of the brain. This test can show the metabolic activity of neoplastic (cancer) cells in the brain using a labelled radiotracer (choline). Hence, it is an imaging and function test of the brain cancer cell, to establish the site where the tumor is most accurately developing. In this case, the patient had a previous surgery without diagnosis, and additionally seizures. It was essential to obtain a biopsy of the lesion, which was representative, in the best place since in these cases there is inflammation and other changes that do not represent the location exact of the tumor. Hence, PET scan is an option to determine the diagnosis.

In previous published cases (1,3,7) in which NMR spectroscopy can establish a metabolically active lesion with some certainty. However, the PET scan represents a comparative advantage, allowing the volume of the metabolically active lesion to be delimited and this image is fused to the Neuronavigation system to obtain a biopsy, and in some cases a direct approach to the lesion and its resection.

In other studies (7,8,9,10,11) was performed a comparative study using MRI and Pet scan fused to MRI in brain tumor biopsy and found no significant difference in post-operative complications between these two groups. However, interestingly, the pathological diagnosis was higher in the MRI alone group. Is possible that at the current moment the PET scan is the best imaging method available for complex cases of tumoral brain lesion, even though, it will require more investigation.

In previous studies (2-12,13,14) it has been established that FD PET does not have sufficient sensitivity compared to other radiotracers; this is the case with choline, which allows better identification of the lesion with more sensitivity. In this case, methionine PET-CT radiotracer was used, allowing the metabolically active volume of the lesion to be accurately established.

It is important to recognize that the PET scan is a procedure imaging diagnosis that must be supported and complemented by others, including MRI (1,2,3,15). In the PET scan can be visualized, others non-tumors lesions such as: paraneoplastic encephalitis, ischemic event. In addition, benign lesions (pituitary adenomas) and non-glial malignant lesions (lymphoma, metastasis). Therefore, a biopsy of this lesion is relevant.

Recent publications (16,17) have identified that PET imaging provides a number of benefits for radiation planning, including improved volume and delineation of radiation targets from normal tissue, potential automation of target delineation and the reduction of intra- and interobserver variability, and identification of tumor sub volumes at high risk of treatment failure that may benefit from dose intensification or adaptive protocols. These concepts will be of great benefit to future patients.

Conclusions

In cases of complex lesions where CT and MRI cannot offer adequate resolution through imaging of the lesion, Pet scan can offer an option to plan an appropriate biopsy of the lesion and obtain representativeness and obtain the best diagnosis. We recommend the use of PET scan in these cases.

Conflicts of Interest

The authors certify that there is no conflict of interest.

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