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**Joint SFMN/ANOCEF focus on 18F-FDOPA PET imaging in glioma: current applications and perspectives**

**La TEP à la 18F-FDOPA dans les gliomes : applications actuelles et perspectives**

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## **Abstract**

18F-FDOPA PET has demonstrated its additional value during the clinical course of glioma, at initial diagnosis, for treatment planning or follow-up. The aim of the current review was to summarize current applications of 18F-FDOPA PET in gliomas and constitute, as a perspective, a first step in harmonizing clinical practices in French centers. In France, the indication for 18F-FDOPA PET is restricted to the assessment of primary brain tumor recurrence. According to the literature, this indication could be expanded to primary diagnosis and, to a lesser extent, treatment monitoring. There is a real need to harmonize standard procedures among French centers. The objective is to increase the availability of data for this rare entity of glioma and to develop multi-parametric PET analyses (static, dynamic and textural), also known as radiomics, by using artificial intelligence algorithms. For this purpose, kinetics analysis with dynamic PET acquisition should be implemented in routine practice because it has demonstrated its additional value for initial diagnosis in gliomas. Therefore, this review proposes a workflow based on acquisition and reconstruction parameters that can be implemented in each center to increase the amount of standardized 18F-FDOPA PET data in neuro-oncology imaging in France. This would help in creating a national database and developing national multi-center studies that can respond to the challenge of using multi-parametric PET in glioma.

**Keywords:** *18F-FDOPA PET, glioma, dynamic analysis, radiomics, neuro-oncology*



## **Résumé**

La TEP à la 18F-FDOPA a démontré son intérêt dans la prise en charge des gliomes, du diagnostic initial au suivi du traitement, en passant par la planification thérapeutique. L'objectif de cette revue est de proposer une vision complète des applications actuelles de la TEP à la 18F-FDOPA dans les gliomes et de constituer en perspectives une première étape d'harmonisation des pratiques cliniques dans les centres français. En France, l'indication de la TEP à la 18F-FDOPA se limite à l'évaluation de la récurrence de gliome. Cette indication pourrait être étendue au diagnostic initial et, dans une moindre mesure, au suivi du traitement, eu égard aux données de la littérature. Il existe un réel besoin d'harmoniser les procédures standards entre les centres français. L'objectif est d'augmenter les données disponibles dans cette entité relativement rare qu'est le gliome, et de développer des analyses TEP multi-paramétriques (intégrant des données statiques, dynamiques et texturales), également appelées radiomiques, à travers des algorithmes d'intelligence artificielle. Pour cela, l'analyse cinétique des acquisitions dynamiques de TEP doit être mise en œuvre en routine car elle a démontré son potentiel dans le diagnostic initial des gliomes. Ainsi, cette revue propose une standardisation des paramètres d'acquisition et de reconstruction pouvant être mis en œuvre dans chaque centre français afin de constituer une banque nationale d'imagerie TEP à la 18F-FDOPA en neuro-oncologie. Ceci pourrait être la base pour le développement d'études multicentriques nationales d'imagerie TEP dans le gliome.

***TEP 18F-FDOPA ; gliomes ; dynamique ; radiomiques ; neuro-oncologie***

## **1 Introduction**

Amino-acid PET tracers have been recommended by the Response Assessment Neuro-Oncology group (RANO) for the assessment of glioma [1]. Brain MRI remains the gold standard for the diagnostic assessment of such entities. However, MRI depends on the disruption of the blood–brain barrier at initial diagnosis. Moreover, MRI could also be limited for the differential diagnosis between residual tumor and post-therapeutics changes in tumors with suspected recurrence [2-4]. Amino acid PET tracers are good candidates relative to MRI in neuro-oncology. Indeed, they cross the intact blood–brain barrier and have relatively high specificity for glioma via the L-amino-acid transporters (LAT) [5].

Three amino-acid PET radiotracers are currently reported for glioma imaging: the historic methionine labeled with C11 (11C-MET) and the 18F-labelled amino acids (i.e., fluoro-ethyl-tyrosine [18F-FET] and fluoro-phenylalanine [18F-DOPA]). In this review, the main points will focus on 18F-FDOPA because this radiotracer is widely available and used in France. Indeed, the French authority Agence Nationale de Sécurité du Médicament (ANSM) allows the use of 18F-FDOPA PET for diagnosis of neurodegenerative parkinsonian syndromes, diagnosis of glomus tumors in patients with a gene mutation of the succinate dehydrogenase D variant and insulinomas in infants and children, diagnosis and staging of pheochromocytomas and paragangliomas, and suspected recurrence of various tumors: primary brain tumors, pheochromocytomas, paragangliomas, medullary thyroid cancers, well-differentiated neuroendocrine tumors of the digestive tract and endocrine digestive tumors when somatostatin receptor scintigraphy is negative (ANSM, May 2008).

<sup>18</sup>F-FDOPA PET has demonstrated its additional value at the initial diagnosis of glioma, during the clinical course, and for treatment planning or follow-up [1]. Of note, its clinical value is more extensively reported for high-grade glioma [6,7].

The aim of the current review is to summarize current applications of <sup>18</sup>F-FDOPA PET in glioma and constitute, as a perspective, a first step for harmonizing procedure standards for imaging glioma in French centers. The objective is to develop national multi-centric studies in this entity of relatively rare incidence [8], taking into account the need for a large amount of data to perform multi-parametric PET, also known as radiomics [9].

## **2      <sup>18</sup>F-FDOPA PET in glioma: current applications**

### **2.1    Initial diagnosis**

The current indication of <sup>18</sup>F-FDOPA PET in glioma in France is restricted to the assessment of recurrent primary brain tumor. However, numerous studies have indicated its interest for initial diagnosis in various indications such as the differential diagnosis, grading or prognostication. Since the detection of glioma with <sup>18</sup>F-FDOPA PET in 1996 [10], numerous studies have explored this amino-acid radiotracer for initial diagnosis. This radiotracer was found more specific than <sup>18</sup>F-FDG PET [11] and to perform as well as <sup>11</sup>C-MET PET [12]. More specifically, quantitative analysis could help increase the diagnostic performance of <sup>18</sup>F-FDOPA PET to distinguish non-neoplastic and neoplastic lesions. With the background ratios of 1.0 and 1.3 for tumor-to-striatum and tumor-to-brain, respectively, the procedure can achieve 96% sensitivity and 86% specificity [11]. The characterization of a cerebral lesion is particularly useful in case of no contrast enhancement on MRI, when <sup>18</sup>F-FDOPA PET could discriminate glioma from benign brain lesions such as dysembryoplastic neuroepithelial tumor [13]. Nevertheless, nuclear physicians should be aware that inflammation processes could lead

to false-positive 18F-FDOPA PET findings. However, in most cases, the observed uptake is below that reported for newly diagnosed glioma [14]. An example of a false-positive case is depicted in **Figure 1**.

The differentiation between low- and high-grade gliomas is also an important finding that could be provided by 18F-FDOPA PET because low- and high-grade gliomas are associated with clearly different treatment strategies [15,16]. Grading with 18F-FDOPA PET is feasible both in newly diagnosed and recurrent gliomas, with 70% to 85% sensitivity and 78% to 100% specificity [17-19]. In this line, a recent meta-analysis showed that 18F-FDOPA PET presents a pooled sensitivity of 0.88 (95% confidence interval 0.81–0.93), specificity of 0.73 (0.64–0.81), and area under the receiver operating characteristic curve of 0.89 (standard error 0.03) for differentiating high- and low-grade gliomas [20]. Of note, this statement should be extended to MRI non-contrast-enhanced lesions [13].

However, there are some inherent difficulties linked to glioma grading with amino acid tracers owing to the oligodendroglial subtype of certain gliomas. Indeed, the oligodendroglial component is known to increase uptake of amino acid tracers in glioma, as reported for 11C-MET and 18F-FET [21,22], thereby potentially leading to overlaps in the classification between low- and high-grade gliomas and thus decreasing the diagnostic performance of amino acid PET tracers in this setting.

The World Health Organization (WHO) has recently changed its classification of glioma by including molecular parameters, particularly the isocitrate dehydrogenase (IDH) isoform mutation and 1p/19q co-deletion, to improve the link with patient prognosis [23]. Recent studies have thus focused on relationships between 18F-FDOPA uptake and molecular parameters. The

prognostic molecular parameter IDH mutation, associated with better response to radio-chemotherapy, can be differentiated in a series of diffuse gliomas (grade II and III gliomas) with higher uptake related to the presence of the IDH mutation [24] and thus better prognosis [25]. However, this relationship did not remain when including glioblastomas in the analysis [26], most exhibiting no IDH mutation [8] and high 18F-FDOPA uptake. A recent publication suggested that glioma without amino acid uptake, which could represent up to 20% of gliomas, should also be informative [27]. Indeed, gliomas with photopenic defects are associated with worse prognosis as compared with those with isometabolic defects, also visualized with 18F-FDOPA PET [27,28]. However, the explanation remains unclear. It could be related to a lower expression of an LAT transporter or reduced perfusion and cellularity in gliomas presenting photopenic defects [27]. An example of MRI non-enhanced glioma, characterized by 18F-FDOPA PET at initial diagnosis, is provided in **Figure 2**.

## **2.2 Treatment planning**

Indications for amino acid PET for treatment planning are increasing and include biopsy guidance, tumor delineation before surgery, or radiotherapy planning [1]. Biopsy guidance is particularly useful for characterizing MRI non-contrast-enhanced lesions, showing heterogeneous uptake on 18F-FDOPA PET, which reflects the tumor heterogeneity. This observation is strengthened by the fact that 18F-FDOPA uptake was associated with high-grade tumor areas in a well-conducted histological validated study [29]. On one hand, the maximum standard uptake value (SUV<sub>max</sub>) of the measured lesion was associated with high grade and cellularity on biopsy. On the other, 18F-FDOPA uptake was more related to higher-grade parts of the tumor than in MRI T1 weighted contrast-enhanced images ( $p=0.01$ ) [29]. More recently, biopsy guidance for MRI non-contrast-enhanced lesions has shown its utility [30]. An example of heterogeneous tumor uptake for biopsy guidance is depicted in **Figure 3**.

The exact tumor delineation is also of great interest because MRI features significant inter-individual variability in delineating the extent of glioma volumes [31]. In a histological controlled study, 18F-FDOPA PET was able to identify the tumor extent in close to 95% of cases. In a few cases, 18F-FDOPA PET revealed the tumor location that was not identified by MRI [32]. This precise tumor extent with 18F-FDOPA PET should be used for radiotherapy planning. However, initial results are moderate because treatment planning using PET-based volumes may not have yielded better outcomes. Indeed, these PET-defined volumes were contained by a 2-cm margin on the MRI Gross Tumor Volume [33]. However, these results are preliminary and need to be confirmed with well-documented studies including a good definition of the PET-defined volumes. Perspectives for radiotherapy planning should most likely be gained with radiotherapy modulation according to 18F-FDOPA PET-based volumes, as previously tested by simulations [34].

### **2.3 Follow-up**

Suspected recurrent or progressive glioma after treatment is the most current indication for 18F-FDOPA PET in France. On one hand, this is the only indication proposed in the marketing authorization by the ANSM. On the other, it takes into account the limitations of MRI to distinguish between recurrent and progressive tumors from pseudo-progression in the first 12 weeks after radio(chemo)-therapy or from radio-necrosis after 12 weeks of treatment [35,36]. This indication has been clearly established [11,17,18,37-39], and performing 18F-FDOPA PET for suspected recurrence provides a clinical impact for multidisciplinary tumor board decisions [40]. 18F-FDOPA PET used to identify tumor recurrence and progression has an accuracy of 82%: visually, using the striatum contralateral to the tumor as the reference, or semi-quantitatively, with a tumor-to-striatum ratio of 1.4 for SUVmax and 1.2 for SUVmean

[37]. Some authors have reported higher accuracy, almost 96%, in this indication [38]. This application is indicated by European recommendations [1]. However, in some cases, inflammation processes could lead to false-positive 18F-FDOPA PET findings, especially if the time from surgery or radiotherapy is short [14]. Two examples of recurrent tumor and post-therapeutic changes are shown in **Figure 4**.

The literature concerning the treatment monitoring response with 18F-FDOPA PET is relatively scarce. Two studies reported results based on anti-angiogenic treatments only [41,42]. Results were encouraging because 18F-FDOPA PET was able to identify responders and non-responders after 2 weeks of treatment with bevacizumab [42]. Further studies involving response to chemotherapies such as temozolomide or procarbazine, lomustine, vincristine (PCV) and monitoring using 18F-FDOPA PET are needed. There is a prognostic value of repeating 18F-FDOPA PET during glioma follow-up because continuous rates of change in PET uptake are an independent predictor of overall survival in low-grade gliomas [43].

## **2.4 Other applications**

In neuro-oncology, 18F-FDOPA PET can be used for the differential diagnosis of radionecrotic and progressive brain metastases, with relatively good accuracy, 83% to 91% [44,45].

From an economic standpoint, the 18F-FDOPA radiotracer can be used in other multiple applications in neurology or oncology for detecting neurodegenerative parkinsonian disorders or neuroendocrine neoplasms [46,47].

### **3 Dynamic analysis: a new parameter to integrate**

According to the French guidelines for 18F-FDOPA PET published in 2010, acquisition parameters in neuro-oncology can involve a static acquisition between 10 and 30 minutes post-injection or a dynamic acquisition at 30 to 45 minutes after radiotracer injection [48]. This rather broad indication leads to disparate acquisition protocols among French centers and most of the time, no dynamic analysis performed.

Thus, almost all studies performed with 18F-FDOPA PET are based on static data with SUV-derived indices such as tumor-to-brain or tumor-to-striatum ratios. However, the dynamic information is not taken into account in this setting but has been shown to increase diagnostic performance when using another amino-acid tracer, 18F-FET [49,50]. In these 18F-FET PET studies, low-grade gliomas are typically characterized by a consistently increasing curve, whereas high-grade gliomas are related more to an early time to peak reached followed by a decreasing curve. Moreover, these dynamic parameters have prognostic value [51-53]. Therefore, 18F-FET PET dynamic analysis has been recommended in recent European guidelines [54].

Dynamic data with 18F-FDOPA PET were analyzed in only a few pilot studies [55-57] by modeling tracer kinetics with multi-compartmental models. These compartmental approaches sometimes need much effort to be implemented in clinical practice. A recent study proposed a simple approach for 18F-FDOPA PET dynamic analysis, easily transposable to clinical practice and comparable to that previously validated for 18F-FET [58]. The approach is based on the evolution of the SUV of the tumor as a function of time. The PET acquisitions start when the patient is injected and are then followed by a 30-minute recording in list mode. Two dynamic parameters are then determined from the curves: the time-to-peak (TTP), corresponding to the



delay between the beginning of the dynamic acquisition (time of tracer injection) and the time of the maximal SUV value (wash-in), and the slope, from the 10th minute of the SUVmean-based curve (wash-out), calculated by linear regression applied on the 10- to 30-minute interval. In this latter study, the prediction of the molecular features of newly diagnosed gliomas with 18F-FDOPA PET, and especially the presence or not of an IDH mutation, may be obtained only with dynamic parameters [58]. A long TTP was associated with IDH-mutated tumors, which are entities of good prognoses, whereas an early TTP was more frequent in IDH wild-type tumors [58]. For detecting glioma recurrence or progression with 18F-FDOPA PET, most of the diagnostic information can be achieved by conventional static parameters as compared with dynamic ones (Abstract Ginet et al. JFMN 2020). Two examples of the additional value of dynamic analysis using 18F-FDOPA PET for glioma at initial diagnosis are provided in **Figure 5**.

#### **4 Toward multi-parametric PET**

The dynamic analysis of 18F-FDOPA PET images in glioma can be extended to a voxel-wise analysis. Similar to what occurs with 18F-FET PET imaging at initial diagnosis, voxel-wise analysis allows for distinguishing high-grade and IDH non-mutated tumors in series of gliomas [59,60]. This innovative approach is based on a reader-independent analysis to characterize the dynamic features of a group of voxels included in the glioma.

In addition to static and dynamic data, textural analyses of amino-acid PET radiotracers of glioma are also promising. Such analysis has been performed with 18F-FET PET for characterizing grade and patient survival with high-grade gliomas [61]. The concept of multi-parametric PET or radiomics applied to PET is based on the analysis of the combination of static, dynamic and textural parameters for assessing the diagnostic performance of amino acid

PET in glioma. For newly diagnosed gliomas with 18F-FET PET, an accuracy of 93% was observed for predicting the presence of IDH mutation [9]. Preliminary results are also available for 18F-FDOPA PET to distinguish recurrence from radiation necrosis in patients with glioblastomas [62].

This concept of radiomics can be expanded to MRI features, which is particularly useful when using a hybrid PET/MR system [63,64] or even with clinical data, which introduces the concept of radio-genomics [65].

For using such valuable analyses in imaging of glioma, a large amount of data is needed, especially in the specific case of glioma, which remains a relative rare entity [8]. Indeed, radiomics analyses are in most cases performed secondary to artificial intelligence analysis and more specifically machine learning, including deep learning. For this purpose, the availability of data is crucial [65]. Moreover, the lack of standardization in both image acquisition and reconstruction represents an issue in developing these analyses [65].

## **5 The necessity of harmonized protocols in French centers**

The acquisition and reconstruction parameters for 18F-FDOPA imaging in glioma are disparate among French nuclear medicine departments. The European Society of Nuclear Medicine in association with the European Association of Neuro-Oncology and the RANO group have recently published new guidelines for imaging glioma using PET with radiolabeled amino acids [54]. To summarize, the indications are extended to initial diagnosis and therapy monitoring. Moreover, acquisition protocols are detailed, including those for 18F-FDOPA imaging, and the dynamic analysis is recommended for 18F-FET PET [54]. Regarding recent literature in 18F-FDOPA PET, a dynamic analysis should also be proposed for 18F-FDOPA PET. Along this

line, the French guidelines for the use of 18F-FDOPA PET in neuro-oncology should be revised, with the implementation of dynamic analysis [48]. A proposed workflow for indications, acquisition and reconstruction parameters for 18F-FDOPA PET in neuro-oncology is in **Table 1**. This workflow includes acquisition and reconstruction parameters given the particular importance to start the acquisition at the time of radiotracer injection. Moreover, there is a need to store raw data for further multicenter trial analyses. Interpretation criteria are also described, associating both visual and semi-quantitative analyses of static and dynamic parameters. For glioma imaging, all analyses should involve the fusion of PET images and recent MRI FLAIR or T1-weighted contrast-enhanced sequences, which improves the diagnostic performance of 18F-FDOPA PET.

Perspectives with 18F-FDOPA PET in glioma are promising. Only well-conducted multi-center studies with harmonized protocols can respond to the challenge of using multi-parametric PET in this setting. The first step is to standardize procedures of 18F-FDOPA PET in glioma for creating a national database.

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## Figure 1

18F-FDOPA PET for characterizing a focal, left mesencephalic gadolinium-enhanced lesion in a 30-year-old woman. Axial slices of T1 weighted contrast-enhanced images (left panel), T2-FLAIR weighted images (middle panel), and 18F-FDOPA PET fused with T1 weighted MR image (right panel). PET shows a high 18F-FDOPA uptake with a tumor-to-striatum ratio of 1.4. The final diagnosis was neuro-Behçet's disease. One-year follow-up MRI revealed that the lesion had almost disappeared after immunosuppressive drug treatment. This case shows that positive 18F-FDOPA PET results can be found in inflammatory processes.

*TEP 18F-FDOPA pour la caractérisation d'une lésion prenant le contraste mésencéphalique gauche chez une femme de 30 ans. Coupes axiales d'images IRM T1 avec injection de produit de contraste (gauche), images pondérées T2-FLAIR (milieu), et d'images TEP / IRM fusionnées (droite). La TEP montre une fixation élevée de 18F-FDOPA avec un rapport de fixation tumeur / striatum de 1,4. Le diagnostic final était une maladie neuro-Behçet. La lésion a presque disparu à 1 an de suivi IRM avec des médicaments immunosuppresseurs. Ce cas montre que la TEP 18F-FDOPA peut entraîner des faux positifs dans les processus inflammatoires.*

## Figure 2

FDOPA PET for initial diagnosis of a right temporo-insular MRI non-contrast-enhanced lesion in a 30-year-old man. Axial slices of MRI T1 weighted contrast-enhanced images (left panel), 18F-FDOPA PET images (middle panel) and fused PET/MRI images (right panel). 18F-FDOPA PET images show intense 18F-FDOPA uptake in the overall lesion, which is well delineated. Tumor-to-striatum and tumor-to-background ratios were 2.6 and 3.9. The final histological diagnosis was isocitrate dehydrogenase (IDH)-mutated non-1p19q co-deleted astrocytoma.



*TEP 18F-FDOPA pour le diagnostic initial d'une lésion temporo-insulaire droite sans prise de contraste en IRM chez un homme de 30 ans. Coupes axiales d'images IRM T1 avec injection de produit de contraste (gauche), d'images TEP 18F-FDOPA (milieu) et d'images TEP / IRM fusionnées (droite). Les images TEP 18F-FDOPA montrent une fixation intense de la lésion, qui est bien délimitée. Les rapports de fixation tumeur / striatum et tumeur / cerveau sain sont mesurés respectivement à 2,6 et 3,9. Le diagnostic histologique final est celui d'un astrocytome IDH muté non codé-lété 1p19q.*

### **Figure 3**

18F-FDOPA PET for biopsy guidance in a 29-year-old woman with left frontal lesion. Axial slices of MRI T1 weighted contrast-enhanced and T2-FLAIR weighted images (left panel), 18F-FDOPA PET images (middle panel) and fused PET/MRI images (right panel). The left frontal lesion shows no contrast enhancement and a homogeneous FLAIR hypersignal. The 18F-FDOPA PET images and fused PET/MRI images show heterogeneous uptake of the lesion with an intense para-cingular uptake (red arrow), which allows for biopsy guidance (IDH-mutated, 1p19q co-deleted oligodendroglioma).

*TEP 18F-FDOPA pour le guidage de biopsie chez une femme de 29 ans avec lésion frontale gauche. Coupes axiales d'images IRM T1 avec injection de produit de contraste (gauche), d'images TEP 18F-FDOPA (milieu) et d'images TEP / IRM fusionnées (droite). La lésion frontale gauche ne présente aucune prise de contraste en IRM et l'hypersignal FLAIR est homogène. Les images TEP 18F-FDOPA et les images TEP / IRM fusionnées montrent une fixation hétérogène de la lésion avec une fixation para-cingulaire intense (flèche rouge), ce qui permet le guidage de la biopsie (oligodendrogliome IDH muté, 1p19q codé-lété).*

#### **Figure 4**

18F-FDOPA PET for suspected recurrence in axial slices of MRI T1 weighted contrast-enhanced images (left panel), 18F-FDOPA PET images (middle panel) and fused PET/MRI images (right panel). The upper row shows a recurrent right temporal tumor 16 weeks after radio-chemotherapy in a 61-year-old man (red arrows). The lower row shows radio-necrosis in a left parietal lesion (green arrows) 12 weeks after radio-chemotherapy in a 51-year-old man.

*TEP 18F-FDOPA pour suspicion de récurrence. Coupes axiales d'images IRM T1 avec injection de produit de contraste (gauche), d'images TEP 18F-FDOPA (milieu) et d'images TEP / IRM fusionnées (droite). La ligne supérieure montre une tumeur temporale droite progressive 16 semaines après la radio-chimiothérapie chez un homme de 61 ans (flèches rouges). La ligne inférieure montre une radionécrose concernant une lésion pariétale gauche, 12 semaines après la radio-chimiothérapie chez un homme de 51 ans (flèches vertes).*

#### **Figure 5**

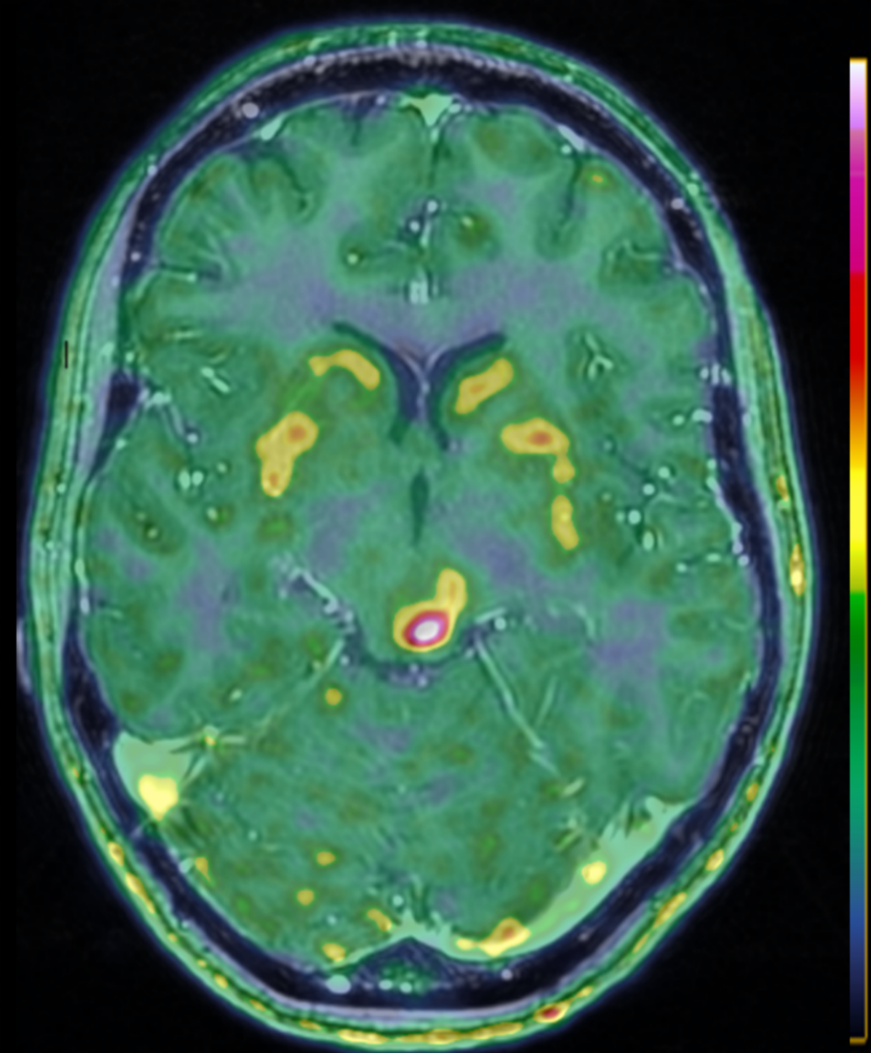
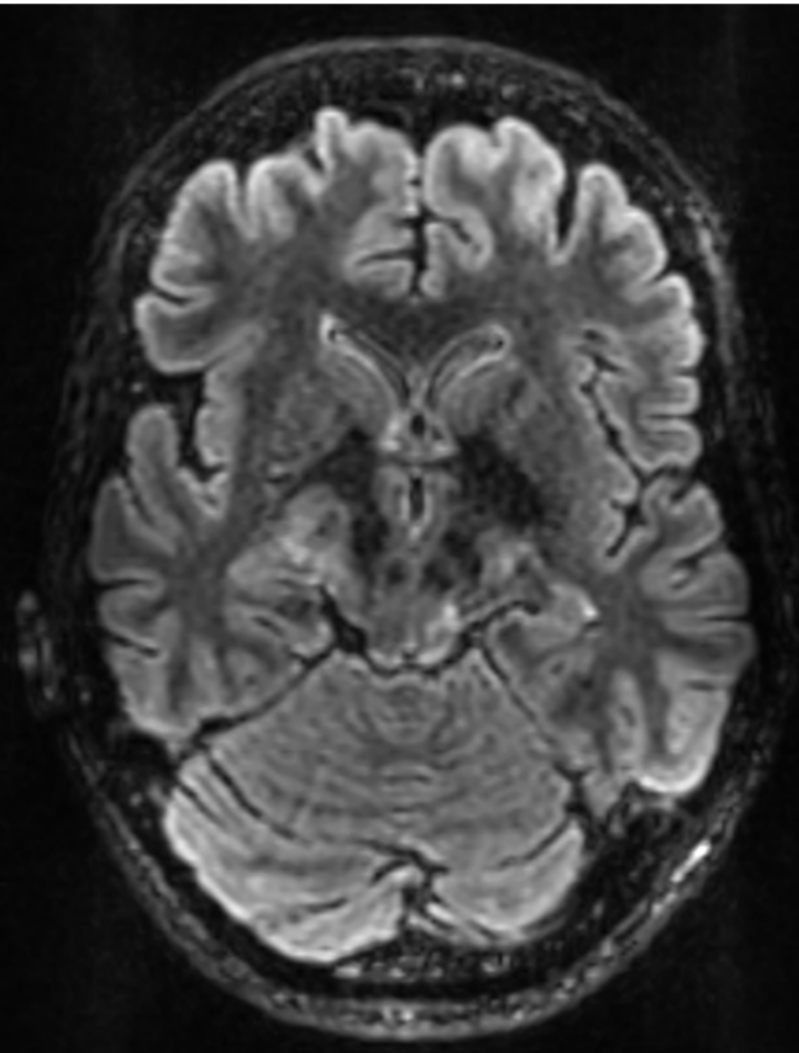
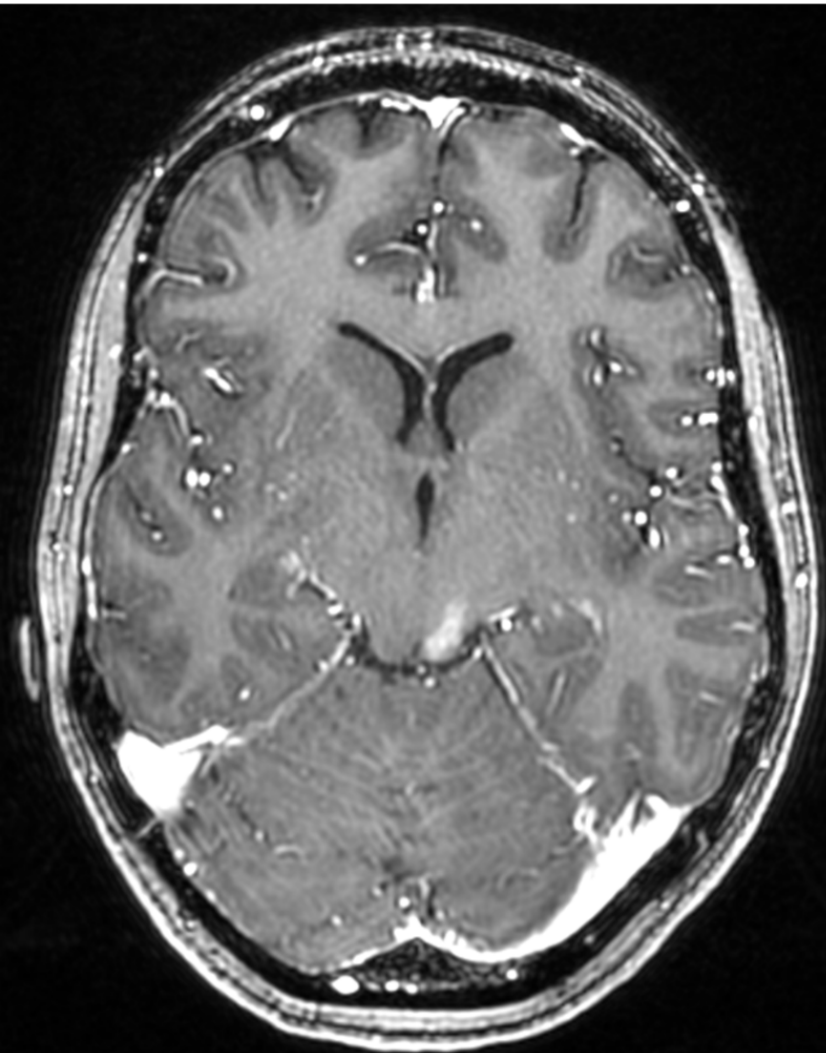
18F-FDOPA PET for characterizing newly diagnosed glioma. Axial slices of MRI T1 weighted contrast-enhanced images (left panel), 18F-FDOPA PET images (middle left panel), fused PET/MRI images (middle right panel) and time-activity curves (TACs, right panel). The upper row shows an intense 18F-FDOPA uptake in a right frontal contrast non-enhanced lesion with tumor-to-striatum and tumor-to-background ratios of 1.6 and 2.3. TACs favored a consistently increasing curve. The final diagnosis was an IDH-mutated 1p19q co-deleted oligodendroglioma. The lower row shows an intense 18F-FDOPA uptake in a right temporo-insular contrast non-enhanced lesion with tumor-to-striatum and tumor-to-background ratios of 1.7 and 2.5. TACs favored an early time to peak, followed by a decreasing curve. The final diagnosis was IDH wild-type glioblastoma.

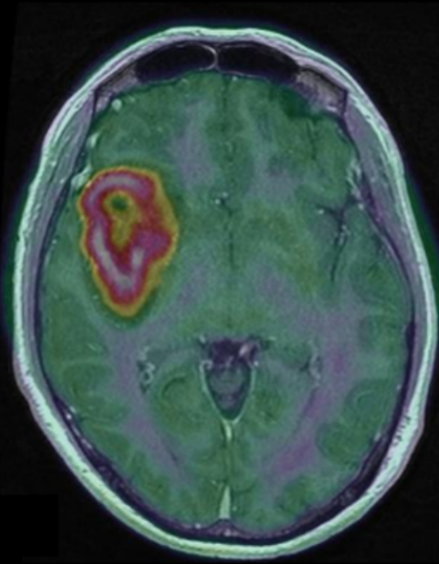
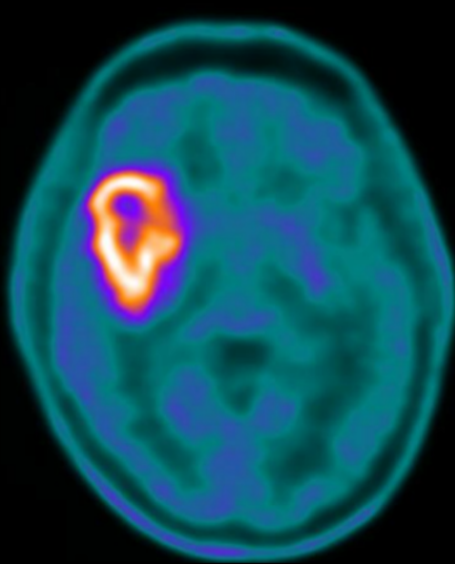
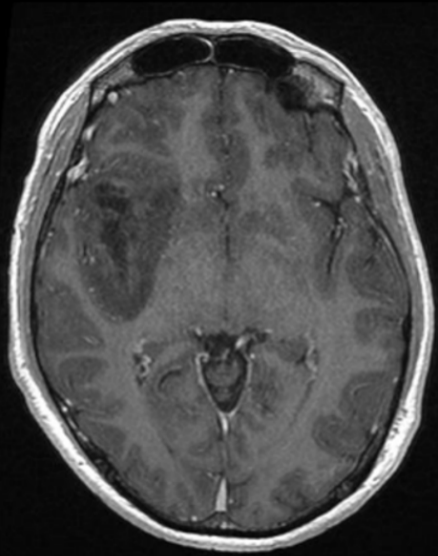
*TEP 18F-FDOPA pour la caractérisation d'un gliome nouvellement diagnostiqué. Coupes axiales d'images IRM T1 avec injection de produit de contraste (gauche), d'images TEP 18F-FDOPA (milieu gauche) et d'images TEP / IRM fusionnées (milieu droite) et courbes activités temps de la fixation tumorale (droite). La ligne supérieure montre une fixation intense de 18F-FDOPA d'une lésion ne prenant pas le contraste en IRM frontale droite avec des rapports de fixation tumeur / striatum et tumeur / cerveau sain de 1,6 et 2,3. La courbe activité temps montre une pente constamment croissante. L'analyse diagnostique finale était un oligodendrogliome IDH muté 1p19q codéleté. La ligne inférieure montre une fixation de 18F-FDOPA intense d'une lésion ne prenant pas le contraste temporo-insulaire droite avec des rapports de fixation tumeur / striatum et tumeur / cerveau sain de 1,7 et 2,5. La courbe activité temps est en faveur d'un pic précoce, suivi d'une pente décroissante. L'analyse diagnostique finale était un glioblastome IDH non muté.*

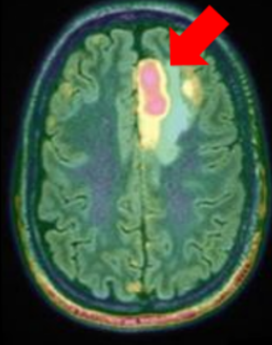
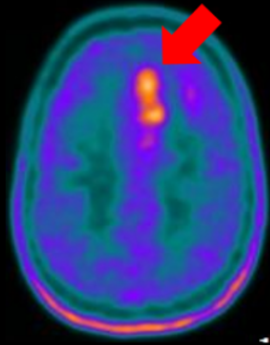
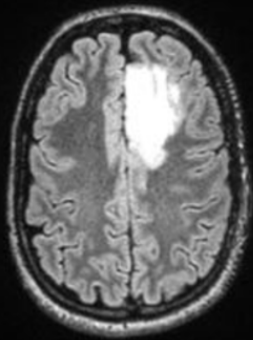
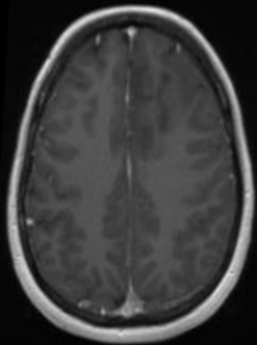
**Table 1.**

Workflow for 18F-FDOPA PET imaging in glioma

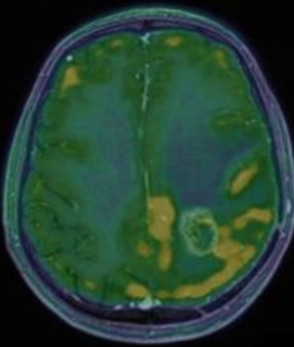
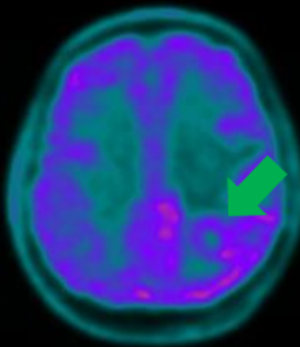
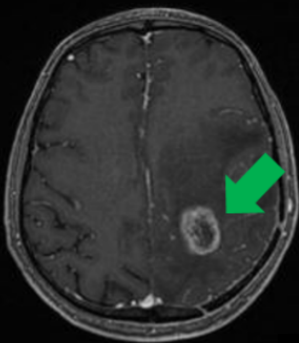
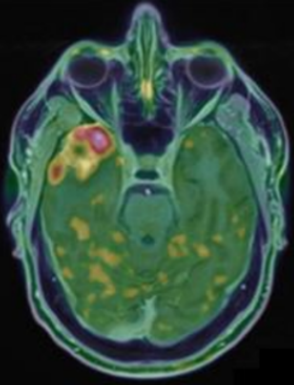
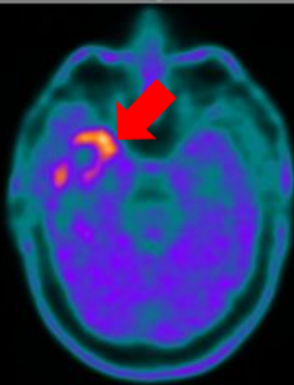
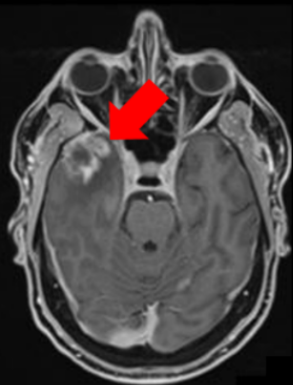
*Workflow pour les images TEP 18F-FDOPA dans les gliomes*

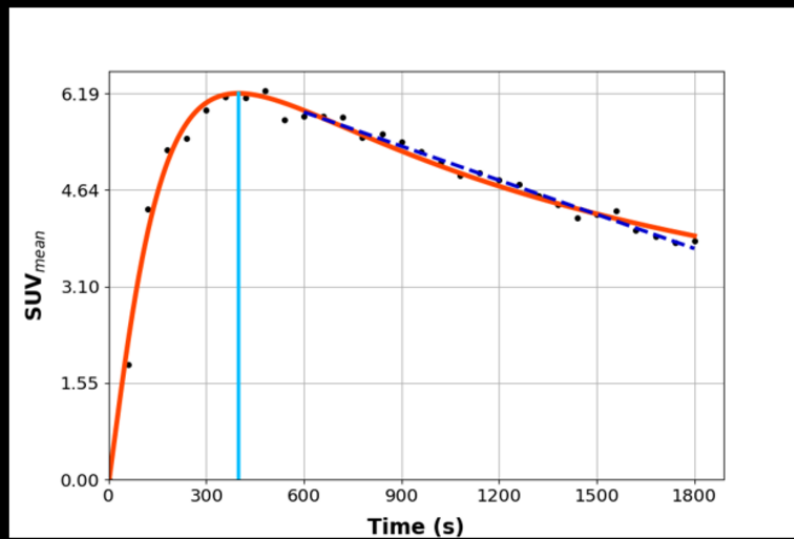
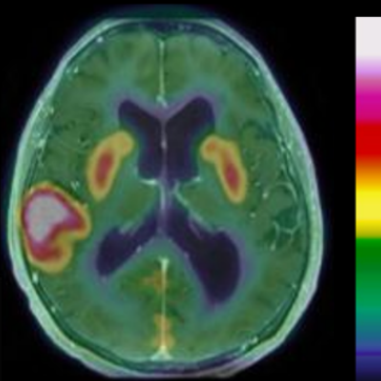
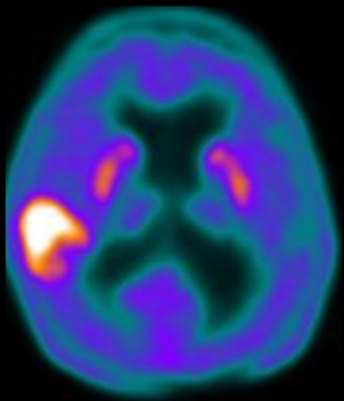
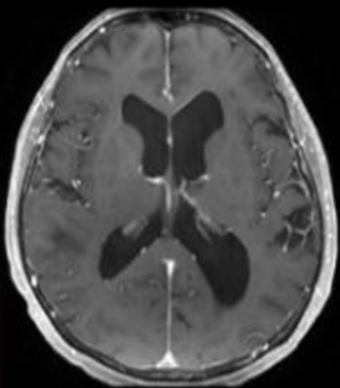
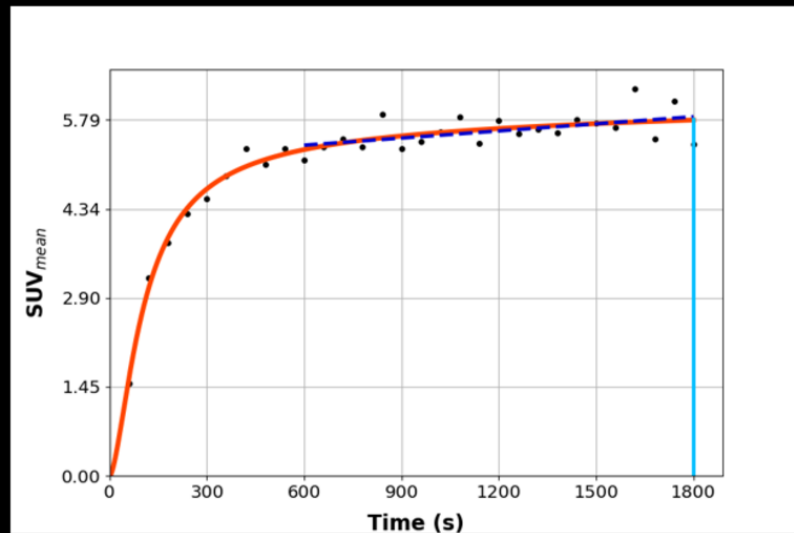
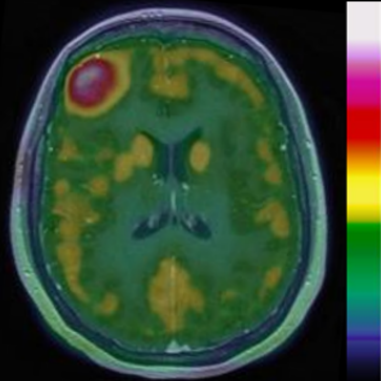
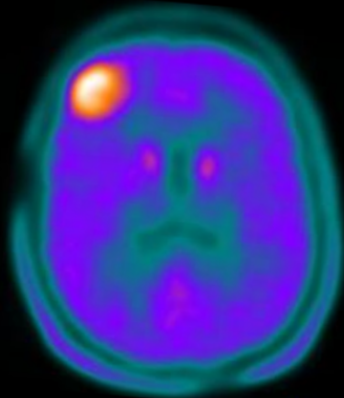
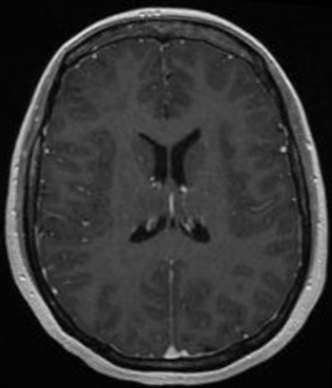














**Table 1**

<b>Indications</b>	<ul style="list-style-type: none"><li>• Initial diagnosis</li><li>• Diagnosis of recurrence</li><li>• Disease and therapy monitoring</li></ul>
<b>Acquisition</b>	<ul style="list-style-type: none"><li>• 4-hour fasting before</li><li>• No premedication by Carbidopa</li><li>• 2 MBq/kg of 18F-FDOPA</li><li>• Dynamic acquisition of 30 min starting when the patient is injected</li><li>• Low-dose CT scan for attenuation correction</li><li>• Single field-of-view PET acquisition</li></ul>
<b>Reconstruction</b>	<ul style="list-style-type: none"><li>• Iterative reconstruction</li><li>• Correction for attenuation, scatter, random</li><li>• No point-spread-function reconstruction</li><li>• Voxel size of 1-2 mm</li><li>• Store the raw data</li></ul>
<b>Interpretation</b>	<ul style="list-style-type: none"><li>• Static between 10 and 30 min after injection<ul style="list-style-type: none"><li>◦ Visual and semi-quantitative analysis (tumor-to-striatum and tumor-to-background ratios)</li></ul></li><li>• Dynamic analysis of 30 frames of 1 min of acquisition<ul style="list-style-type: none"><li>◦ Visual and semi-quantitative (time-to-peak and slope between the 10<sup>th</sup> and the 30<sup>th</sup> minutes)</li></ul></li><li>• Fusion with MRI (T1-weighted sequence when contrast-enhanced lesion, if non FLAIR sequence).</li></ul>