Pituitary Metastasis and the Role of CSF Pulsations in Secondary Displacement after Surgery

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Abstract

The differential diagnosis between pituitary metastasis and adenoma remains challenging in patients with an oncological history, as imaging features on MRI and 18F-FDG PET-CT are not highly specific. We report here a case of pituitary metastasis in a patient with a history of breast carcinoma and we describe the clinical and radiological details before and after surgery, in order to plan the best patient’s tailored strategy. The postoperative follow-up permitted to detect the secondary displacement of the remaining tumor, which was primarily attributed to cranio-caudal CSF pulsations. This phenomenon allowed scheduling the correct timing for the adjuvant treatment.

Keywords: Pituitary Lesion; Pituitary Metastasis; Trans-Sphenoidal Surgery; CSF Pulsations; CSF Flow

Introduction

Pituitary metastases are a very rare disease [1,2]. However a high index of suspicion should be kept in front of patients with an oncological history and a pituitary lesion.

We document here a case of pituitary metastasis, whose diagnosis was suspected on the basis of the characteristics at the preoperative MRI and 18F-FDG PET-CT and it was then confirmed by pathology. Thereafter we describe how the radiological follow-up could help in scheduling the correct timing for the institution of adjuvant therapies, in this case through the detection of the secondary intrasellar descent of the remaining tumor, probably due to the rhythmic CSF pulsations.

Case Presentation

A 40-year-old female patient presented to the emergency department with fatigue, dizziness and polyuria lasting for three weeks. She had a history of bilateral mastectomy for an invasive ductal carcinoma three years earlier. Neurological examination was normal, while biochemical examination showed a slight hyperprolactinemia of 94 mcg/L (normal range of 4–25 mcg/L). No clinical or biological signs of anterior hypopituitarism were present, while the diagnosis of diabetes insipidus was confirmed. CA 15-3 was slightly elevated. A whole-body positron emission tomography/computed tomography (PET-CT) using 18F-fluorodeoxyglucose (18F-FDG) revealed an intensely avid nodular lesion in the sella turcica. No other hypermetabolic lesions were detected. Quantification of pituitary metabolic activity was obtained by using the maximum standardized uptake value (SUVmax) and the exam showed a precocious SUVmax at 6.2 becoming 8.9 in the late sequences (Figure 1A). Cerebral MRI showed a thickened pituitary stalk and a partially necrotic sellar lesion measuring 14 × 17 × 14 mm, which extended to the left cavernous sinus and the suprasellar area, indenting the optic chiasm (Knosp 2, Hardy B). In T1-weighted MRI with gadolinium administration the mass showed a strong contrast enhancement extending along the pituitary stalk with a rich vascularization pattern and a clearly visible intratumoral vessel (Figure 1B).

The patient was initially considered for treatment through stereotactic radiosurgery. However, the diagnosis being uncertain, and given the contact of the lesion with the optic chiasm, surgery was preferred. The lesion was subtotally excised through a trans-sphenoidal approach using an entirely endoscopic technique and the tumor appeared more solid that a typical pituitary adenoma and highly vascular. It was not possible to identify the limits between the anterior and the posterior pituitary. Pathology revealed HER2-positive tumor cells in acinar formations, around necrotic areas, compatible with a poor differentiated carcinoma.

Figure 1: A: Preoperative 18F-FDG PET-CT showing an 18F-FDG avid sellar mass. B: Preoperative T1-w cerebral MRI with contrast administration showing a sellar mass with a large vessel, possibly indicative of a pituitary metastasis. C: 24 hours post-operative T1-w MRI with contrast administration showing a suprasellar remaining tumor (white arrow) in contact with the optic chiasm (the right optic nerve is marked with a yellow arrow). D: 1-month post-operative T2-w MRI showing a descent of the remaining tumor (white arrow) with a clear distance of 2 mm from the optic chiasm (right optic nerve marked with a yellow arrow).
Postoperatively she recovered from her diabetes insipidus and showed no signs of anterior pituitary insufficiency. The ophthalmologic evaluation remained normal. The 24-hours postoperative MRI showed a suprasellar residue measuring 6 × 7 × 8 mm and its contact with the optic chiasm precluded immediate stereotactic radiosurgery (Figure 1C). The treatment was deferred until one month post-operatively, when a new MRI showed a descent of the same residue at a distance of 2 mm from the optic chiasm (Figure 1D). This allowed stereotactic radiosurgery treatment with Leksell Gamma Knife Perfoxion (20 Gy at isodose 50%, with a maximal dose of 7.7 Gy delivered to the optic tracts) and she was referred to her regular oncologist for multidisciplinary follow-up. She was still alive two years after surgery.

Discussion

Pituitary metastases are rare (< 1% of all intracranial metastases) and about 5% of patients with known malignancies present latent pituitary metastases in autopsy series [2]. Breast cancer is the most common primary site (followed by lung cancer in the male population) and symptoms are reported in a minority of cases (2.5 – 18.2%) [3–5]. Diabetes insipidus is the most frequent symptom, reflecting a predilection of metastases for the posterior lobe, probably because of the presence of a direct arterial supply [1,2].

In our case the clinical presentation was marked by diabetes insipidus, the cerebral MRI showed a pathological pattern of vascularization, a necrotic central area, and a contrast enhancement extending along the pituitary stalk, features that may be more indicative for a pituitary metastasis. The whole body 18F-FDG PET-CT showed a high metabolic nodular lesion in the sellar turcica. Normal pituitary tissue does not accumulate 18F-FDG and physiologically pituitary glands are not visualized [6]. For non-functioning adenomas, 18F-FDG PET scans are usually negative, because of the low metabolic activity that is often similar to normal cells. However, the cells of functioning tumors may be more active and some studies report that functioning pituitary macro- and microadenomas can show increased FDG uptake on PET [7–10]. In our patient the 18F-FDG PET-CT showed a precocious SUVmax at 6.2 becoming 8.9 in the late sequences. This trend of increased metabolic uptake remains highly suspicious for a pituitary metastasis.

We would also like to illustrate the importance of postoperative follow-up MRI to detect the secondary displacement of an eventual remaining tumor, in the perspective of adjuvant therapies. The progressive displacement of the residual lesion observed when comparing the first postoperative image and the 1-month control may be attributed to rhythmic CSF pulsations. CSF pulsations result from changes in blood volume in the closed craniospinal cavity [11] and the CSF flow is also strictly dependent from the respiratory cycle [12]. During systole, the net blood inflow induces a cranio-caudal CSF displacement [13].

Intracranial pressure varies according to the hemodynamic parameters and the central nervous system may be considered as a microcosmus with its microgravity environment [14]. This equilibrium may be altered after surgical procedures and in our case a subtotal resection of the sellar lesion probably favored the descent of the suprasellar residue because of the liberation of a space primarily filled of CSF and then by tumor.

However we may only hypothesize that this phenomenon was responsible for the secondary displacement of the remaining tumor because no phase-contrast MRI was performed to assess the amplitude and direction of CSF pulsations in the sellar area. In our knowledge this is the first description of the role of CSF dynamics in determining a secondary displacement of residual tumor in the context of metastatic intrasellar pathology.

Treatment for patients with pituitary metastases is basically palliative but it depends from the extent of the oncologic disease [15]. Local radiation and chemotherapy are the first choice in patients with multiple metastases, while surgery should be considered, alone or followed by radiotherapy, to clarify the diagnosis or to relief symptoms in cases of visual deterioration or cranial nerve palsy [15].

The prognosis is generally poor and most patients die within some months [2,16]. Only 10% of patients are alive at one year after diagnosis [16]. The presence of an isolated pituitary metastasis may determine a better prognosis [15], as in our case, where the patient presented a systemic involvement under control and was still alive two years after the surgical treatment.

Conclusions

In oncologic patients the differential diagnosis between pituitary adenoma and sellar metastasis is challenging. The diagnostic orientation is based on the oncological history, the clinical presentation and the radiological features indicative for malignancy. The combination of an endoscopic transphenoidal subtotal resection and stereotactic radiosurgery may allow preservation of visual function and maximize the local oncological disease control. In our case we believe that the CSF pulsations constituted a key factor in determining the displacement of the residual tumor; far from the optic chiasm, thus allowing the adjuvant radiosurgery and improving the quod vitam prognosis of this patient.

References


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