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Metastatic renal cell carcinoma in an olfactory meningioma

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ABSTRACT

We report a case of renal cell carcinoma metastasing to an intracranial meningioma which has only been reported in eleven previous cases. A 55 year old man had previously undergone radical nephrectomy and developed pulmonary and gluteal metastasis in the following years, requiring pulmonectomy and surgical resection with combination of chemo and radiotherapy. As neurological symptoms developed, cranial MRI confirmed tumor within the anterior cranial fossa. Pathology confirmed the presence of metastatic renal cell carcinoma nidus with a surrounding meningioma. Positive history of extracranial cancer, rapid onset of new neurological signs or deteriorations, atypical radiological findings should raise the suspicion of potential metastases.

1. Introduction

Metastatic tumor arising in an intracranial meningioma is rare and has been described in breast, kidney, gastrointestinal and lung tumors. Tumor-to-tumor metastasis was first reported in 1902 by Berent [2]. The most common reported tumors are from lung and breast and gastrointestinal malignancy. Here we describe a case of renal cell carcinoma metastasing to an intracranial meningioma which has only been reported in eleven previous cases [6,8,10]. In the intracranial compartment the most common tumor in which a metastasis has been found is meningioma [7]. We describe a case of renal cell carcinoma found within an olfactory meningioma.

2. Case report

A 55 year old man was admitted with a short history of occipital headache and nausea. Neurological examination demonstrated left third nerve palsy and diplopia. He had previously undergone a right radical nephrectomy for tumor. Histology showed a grade 1 clear cell carcinoma with areas of Fuhrman grade IV (pleomorphism and multinucleate giant cells confirmed). One year after renal surgery he presented with pulmonary metastasis and required a right pulmonectomy and a combination of chemo and radiotherapy. Three years later he required surgical resection of a left gluteal metastasis and renal cell carcinoma was again confirmed. At this admission cranial MRI showed a tumor 5.5 cm in diameter contained within the anterior cranial fossa. Contrast enhancement was non-homogeneous and extensive peritumoral edema was present (Fig. 1). A right supra-orbital craniotomy was performed and an olfactory groove tumor was found and gross total resection acheived and the patient made an uncomplicated recovery. At one year showed there was no neurological deficit and cranial MRI showed no signs of tumor recurrence.

The histopathological evaluation revealed two morphologically distinct areas, a central necrotic tumor composed of polygonal shaped clear cells and scanty stroma, which is rich in capillaries, and this area is surrounded by a second component like a rim, it is composed of syncytial growing spindle cells focally with whirl formation (Fig. 2). Clear cell component had high-grade cytologic atypia and reached the surrounding cortical tissue in small areas, but no intra-axial invasion was confirmed. Both tumor components were positive with EMA[1] (epithelial membrane antigen), a characteristic feature of meningiomas and renal parenchyma tumors, and negative with S100 protein (Fig. 3). The clear cell component showed strong positivity with CAIX[2] (carbonic anhydrase IX) and Pax8[3] (paired-box gene 8), but the other tumor was negative with these markers (Fig. 4a,4b). CAIX is a well-described enzyme in renal cell carcinoma known for interfering with hypoxia

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[1] EMA: epithelial membrane antigen.
[2] CAIX: carbonic anhydrase IX.
[3] Pax8: paired-box gene 8.

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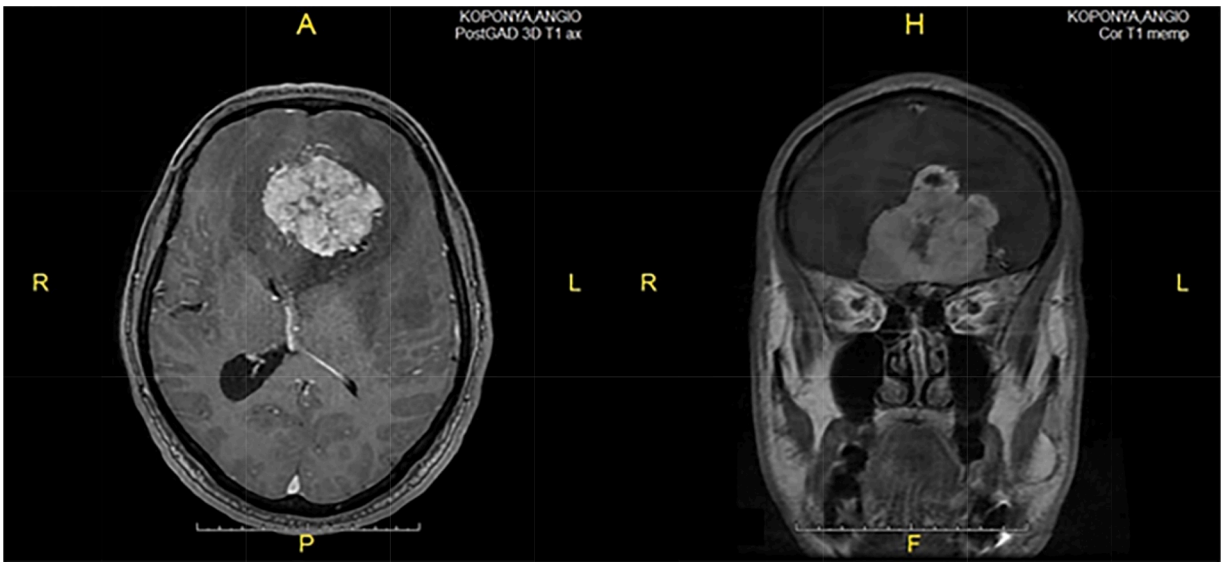

Fig. 1. Cranial MRI with contrast enhancement revealed a well circumscribed tumor with central necrosis, 5.5 cm in its greatest dimension, filling the anterior cranial fossa. The contrast enhancement was non-homogeneous and peritumoral oedema surrounded the tumor.

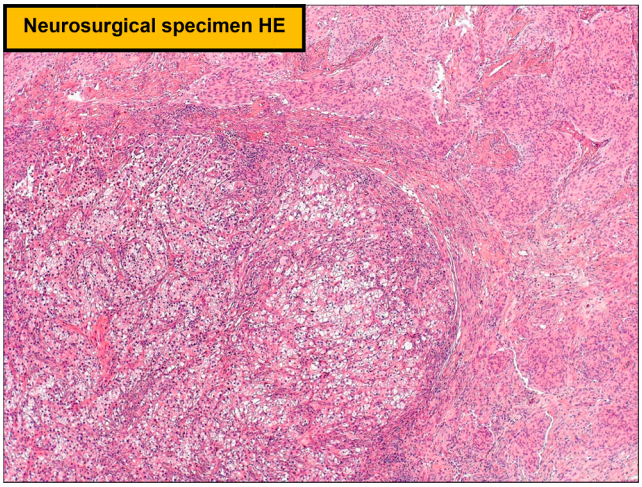

Fig. 2. The histopathological evaluation revealed two morphologically distinct areas, a central necrotic tumor composed of polygonal shaped clear cells and scanty stroma, which is rich in capillaries, and this area is surrounded by a second component like a rim, it is composed of syncytial growing spindle cells focally with whirl formation.

processes. Cell lineage-specific transcription factor Pax8 plays a crucial role in the organogenesis of the kidney. The progesterone receptor marker showed strong nuclear staining in the meningioma component, it's known as a prognostic marker for a later recurrence.

The histopathological examination confirms a diagnosis of a clear cell renal cell carcinoma metastasis in a Grade I meningothelial meningioma.

3. Discussion

To date 11 cases of renal cell tumor metastastasising to an intracranial meniongioma have been described [10]. Although it is still a rare phenomenon, but the constantly increasing reported cases of tumor-to-tumor metastasis prompts us to obtain better knowledge of the precise mechanisms. As meningiomas are the third most frequent tumor type in large series of tumor-to-tumor metastases, neurosurgeons should be aware of this entity [13].

There is some debate in the literature why meningiomas are the most frequent central nervous neoplasm to host metastasis, but the following theories are maybe the most likely ones: 1) enviroment due to the low metabolic rate 2) long-standing and indolent growth of meningioma provides extended exposure to primary tumor 3) high collagen and lipid content of meningiomas provide a "fertile soil" for seeding distant primary tumor cells, 4) complex interaction of hormonal (especially E-cadherin expression), immunological and enzymatic factors, 5) increased likelihood of tumor cell adherence that may occur due to low flow rate within intracranial venous system or due to rich vascular supply that may act as a vascular filter [1,5,11,12,14].

A review of 20 cases of metastatic carcinoma disclosed several interesting facts; 1) metastasis to an intracranial meningioma or neurilemmoma was twice as frequent in autopsy material as in surgical material, 2) this phenomenon was twice as common in females, 3) adenocarcinoma of the lung in males and of the breast in females were the most commonly encountered donor tumors, 4) the metastasizing tumor was always found to be widely disseminated in autopsy studies, 5) despite the presence of widespread metastases, the existence of the primary carcinoma was known prior to autopsy in only about 60 % of cases, 6) CNS[4] symptoms were present in 2/3 of the patients, however, additional metastases to organs outside the CNS were more common in those without symptoms [4].

According to recent Turkish literature review of tumor-to-tumor metastases, the number of cases where kidney tumor hosted a metastasis to meningioma was only 11 so far [6,8]. In 8 cases renal cell carcinoma (1 with doubt), in 1 case adenocarcinoma and in 1 case only carcinoma was named as primary tumor. Five cases were subtyped into: three meningothelial, one lipomatous and one anaplastic [8].

Routine radiological imaging techniques, such as CT and MRI are not reliable to identify or exclude tumor-to-meningioma metastasis. On CT images metastasis within meningioma characterized as a hyperdense area, or as a hypodense area when it is associated with necrotic components. Atypical signal characteristics on conventional MRI also considered as a warning sign for tumor-to-tumor metastasis. Among imaging methods perfusion MRI and MR spectroscopy can help us in noninvasively differentiating tumor histology. Differences in microvascular structures and hemodynamic properties of meningioma and other metastatic tumors therefore make perfusion MR imaging a useful tool.

[4] CNS: central nervous system.

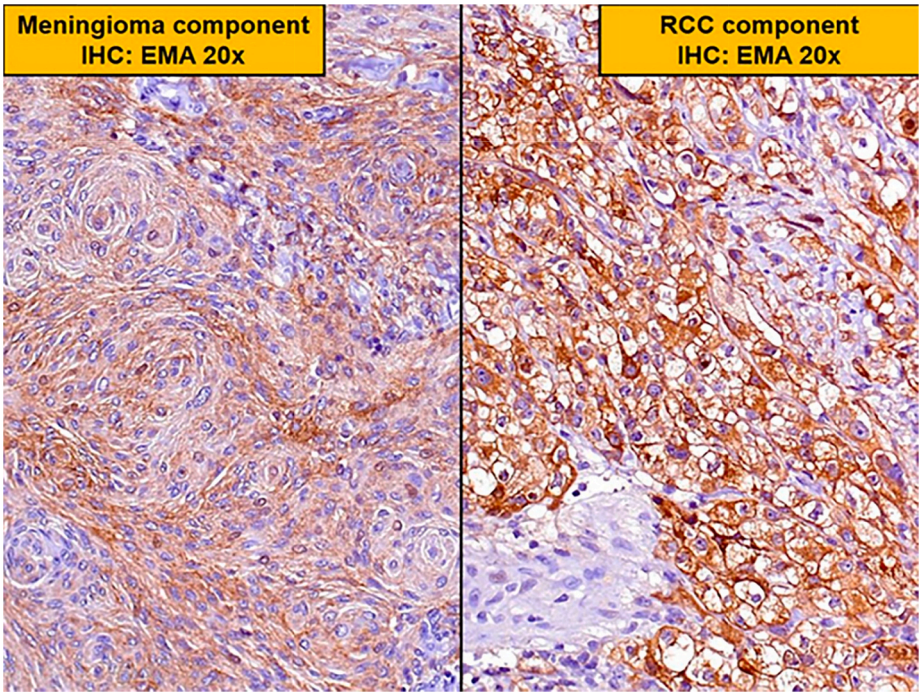

Fig. 3. The histopathological evaluation revealed that both tumor components were positive with EMA (epithelial membrane antigen). EMA immunoreactivity is a characteristic feature of meningiomas and renal parenchyma tumors.

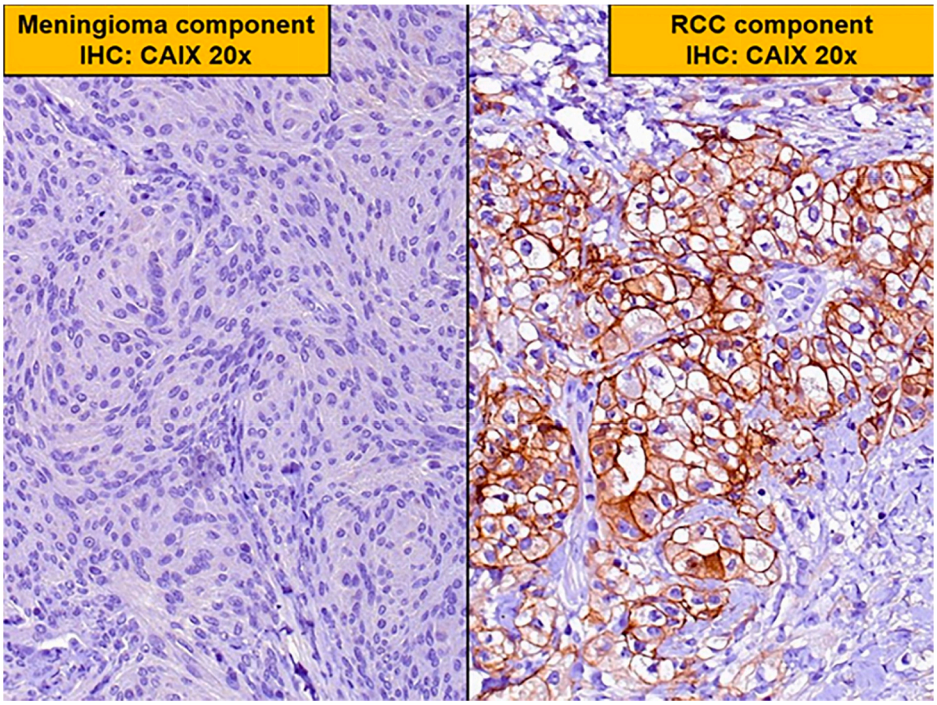

Fig. 4a. The clear cell component showed strong positivity with CAIX (carbonic anhydrase IX) and Pax8 (paired-box gene 8), but the other tumor was negative with these markers. CAIX is a well-described enzyme in renal cell carcinoma known for interfering with hypoxia processes. Cell lineage-specific transcription factor Pax8 plays a crucial role in the organogenesis of the kidney.

Meningiomas known as densely capillarised, and will show great T2 signal intensity fall with greater regional cerebral blood volume (rCBV[5]). On the other hand, adenocarcinomas due to their high mucin content, have more diffusely spaced capillaries correlating with smaller T2 signal intensity drop and rCBV [9]. MR spectroscopy provides metabolic composition for tissue samples. Increases in lipid/creatinine and alanine/creatinine ratios have been able to distinguish metastasis and meningiomas from other intracranial tumors, respectively. The degree of malignancy of lesions has been correlated with an increase in the lactate/creatinine ratio [3]. Despite MR spectroscopy and perfusion MR imaging can give an aid, histopathological examination remains the

[5] rCBV: regional cerebral blood volume.

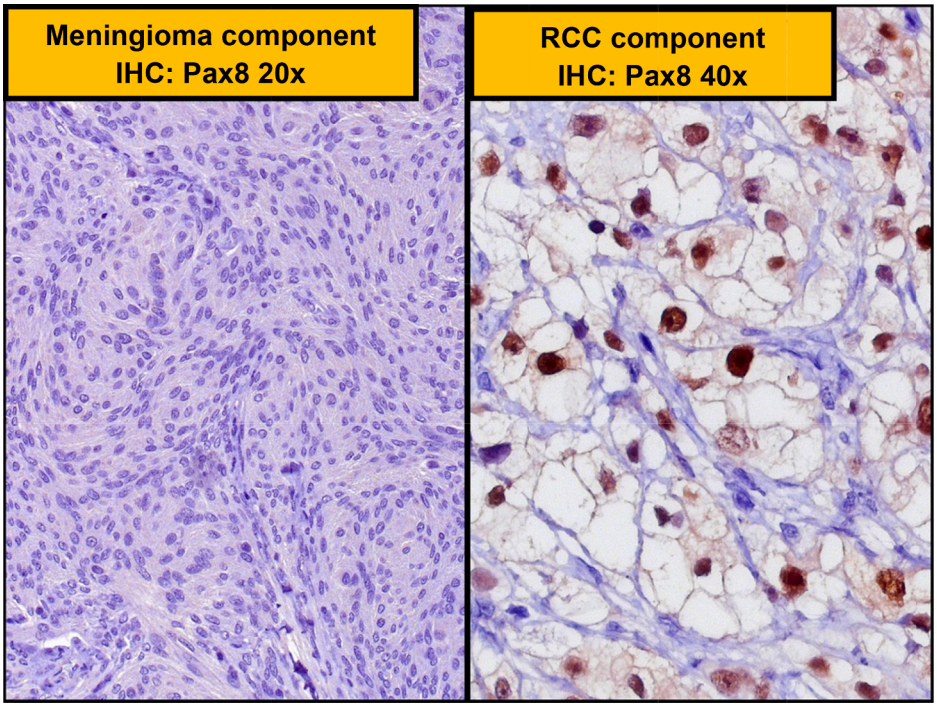

Fig. 4b. The clear cell component showed strong positivity with Pax8 (paired-box gene 8). Cell lineage-specific transcription factor Pax8 plays a crucial role in the organogenesis of the kidney.

only reliable method of diagnosing the presence of metastasis within a meningioma.

4. Conclusion

The phenomenon of tumor-to-tumor metastasis is a rare event to face with, but neurosurgeons should be aware of this entity. Past medical history with extracranial cancer, rapid onset of new neurological signs or deteriorations, atypical radiological findings are warning signs of this problem. So far there is no confirmed way for preoperative diagnosis of tumor-to-tumor metastasis, indication for surgical removal of intracranial tumor not changed. However where tumor-to-tumor metastasis is considered a possibility, then en bloc removal of the tumor should be considered to prevent seeding of metastatic cells intraoperatively.

Ethical approval

This article contains studies with human participants performed by any of the authors. The registration number of the ethical approval is 5151–2022.

Informed consent was obtained for experimentation with human subjects.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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