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Case Report

Meningioma as the host for metastatic breast cancer: A rare occurrence with important therapeutic impact

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ABSTRACT

Background: Tumor-to-tumor metastasis is a rare condition. There are few reports of metastatic tumors within intracranial tumors, including meningiomas. Since some metastatic tumors have osteoblastic imaging pattern, it is not always easy to differentiate them from meningioma on preoperative studies.

Case Description: A 60-year-old female referred to our center complaining about a progressive headache, nausea, and vomiting for the past month. She had a history of breast cancer treated with radical mastectomy (5 years ago) and adjuvant chemotherapy (until 1 year ago). Workups revealed a dural-based mass in the left temporobasal and midline subfrontal regions. Histopathological study showed breast cancer metastasis nests within the primary meningioma.

Conclusion: As the diagnosis of metastatic nests inside a benign tumor, drastically alters postoperative adjuvant treatments, a high index of suspicion is needed evaluating tumors from patients with a history of systemic neoplasms.

Keywords: Brain metastasis, Breast cancer, Intracranial metastasis, Meningioma, Skull base

INTRODUCTION

Tumor-to-tumor metastasis is a rare phenomenon. Since the first description by Fried in 1930,[13] <100 reports of metastatic seeding of a malignancy within another histologically distinct tumor have been reported in the literature.

Metastases of systemic neoplasms to intracranial ones are even more rare, but have been reported to occur within different intracranial tumors including meningiomas.[1-3,10,15,18] Meningioma has been reported to receive nests of metastatic tumor cells from different origins including lung, breast, genitourinary, and gastrointestinal tracts.[5] Variable hypotheses such as hemodynamic and flow-related, hormonal, and immunologic mechanisms and cell surface receptors have been proposed to be implicated. However, the underlying pathways are not precisely clarified.[1-3,10,15,18]

Hereby, we describe our experience with a rare case of metastasis within skull base meningioma in a patient already treated for ductal carcinoma of breast and review the pertinent literature.

CASE PRESENTATION

A 60-year-old female was referred to our center with a progressive headache started 1 month ago and nausea/vomiting during the past week. Neurological examination was intact except for mild bilateral papilledema. She had a history of breast cancer (invasive ductal carcinoma, progesterone receptor [PR] positive, and HER-2 positive) treated by radical mastectomy 5 years ago, followed by adjuvant chemotherapy. She was regularly followed up by the oncologist. There was no evidence of metastatic spread and/or local recurrence and her cancer was reported to be in remission for 2 years ago.

A brain CT was done [Figure 1a and b] showing a dural-based mass with hypertrophic adjacent skull base bone. Brain MRI with postcontrast images revealed an avidly enhancing extra-axial lesion in the left temporobasal and midline subfrontal region with poorly demarcated margins from the left temporal lobe [Figure 1c and d].

After obtaining the patient's informed consent, surgery was planned with the differential diagnoses of meningioma versus skull base metastasis. She was operated through a left frontopterional craniotomy. Tumor's consistency was firm and the gross appearance was compatible with meningioma. The piecemeal removal of the tumor and microsurgical drilling of the involved bone were done as much as possible. The involved dura was also removed and reconstructed with pericranial fascia. After the surgery, the patient was admitted to neurosurgical ICU and after 24 h of close observation with no specific postsurgical complications, was transferred to the neurosurgery ward. The patient was discharged from the hospital 8 days after surgery without any neurological deficit.

Histopathological study of the tumor revealed a WHO Grade 1 (WHO 2016 classification) meningioma containing nests of metastatic breast carcinoma in hematoxylin and eosin staining [Figure 2a-c]. Immunohistochemistry studies showed hormonal receptors to be the same as the patient's breast carcinoma. These findings confirmed tumor-to-tumor metastasis and determined the metastasis source from breast carcinoma [Figure 2d-h]. The cranial mass sample as well as the previous breast mass harbored focal areas of immunoreactivity with PR on immunohistochemistry staining [Figure 2h].

Postoperative systemic metastasis workup (including PET scan) was clear and there were no signs of other metastatic foci. The patient was referred to oncologist for adjuvant chemoradiation therapy for skull base metastatic tumor.

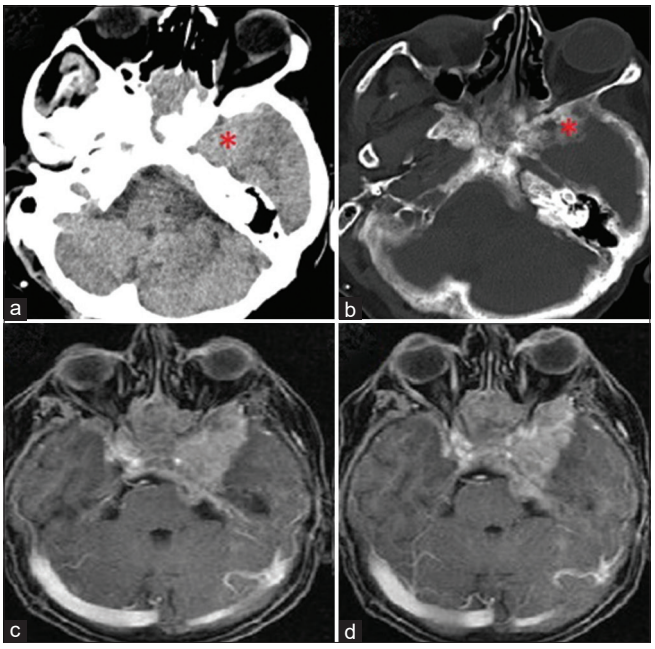

Figure 1: (a and b) Axial computed tomography scan showing a left temporobasal lesion with hypertrophic bone changes. (c and d) Axial postcontrast magnetic resonance imaging showing an extra-axial left temporobasal lesion with extension to the midline subfrontal region with poorly demarcated margins from the left temporal lobe.

DISCUSSION

The interrelation of meningioma and breast cancer is controversial in the existing literature. An early study by Schoenberg *et al*. reports an association between breast cancer and meningioma to such an extent that women with either condition have a higher risk of being diagnosed with the other one.[25] Some other studies report no role of these conditions in development of each other,[7] while another study by Custer *et al*. suggests that shared risk factors may account for this relative epidemiological association.[8]

Both meningioma and breast cancer are assumed as hormone-sensitive tumors frequently harboring PRs.[10,11,20,24-26] This may be taken into account when considering hormonal therapies for metastatic breast carcinoma as well as meningioma. The study of Sun *et al*. stated that tamoxifen therapy could be associated with a reduced risk of meningioma in breast cancer patients receiving long duration or high cumulative dosage of tamoxifen.[27]

Another possible reason for this correlation in incidence is suspected to be the usage of cranial imaging for staging and/or follow-up, particularly among women with more advanced breast cancer.[21]

The first case of metastasis to meningioma was explained by Fried in 1930.[13] Moody *et al*. suggested that meningiomas without psammoma bodies within the tumor are more susceptible to receiving metastatic tumors and concluded that they might have a protective role against metastatic cells.[22]

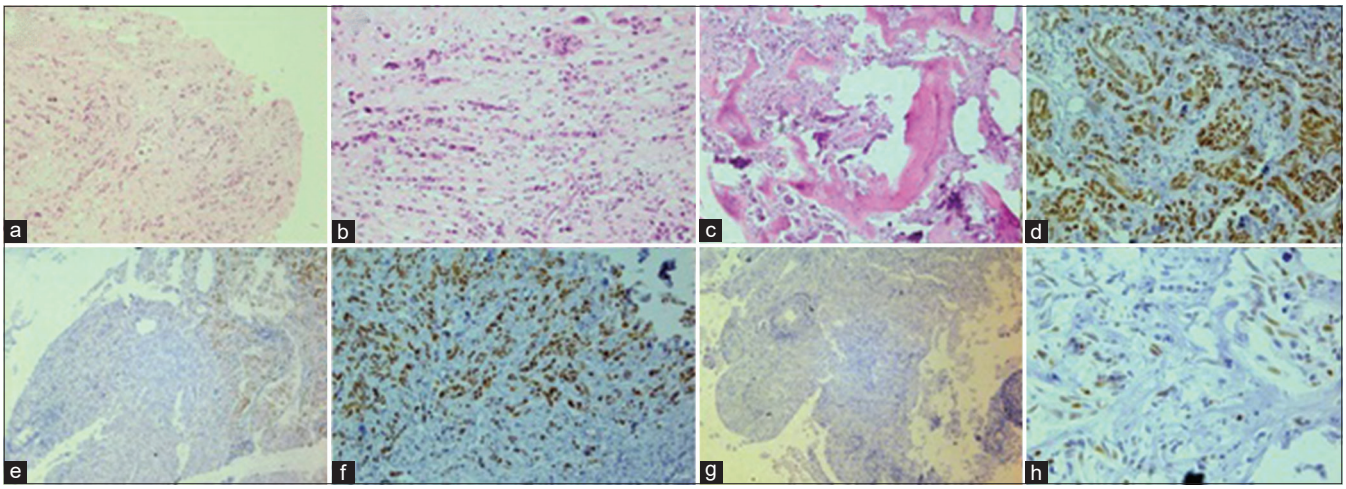

Figure 2: (a) Hematoxylin and eosin staining (H & E, ×100) showing dura mater involved with meningioma and invaded by a tubule glandular forming tumor; an unusual feature for meningioma. (b) There are prominent nuclear atypia and "Indian filing" (H & E, ×200); both of them unfamiliar to meningioma and indicating invasive breast carcinoma. (c) Bone tissue infiltrated with atypical epithelial cells (H & E, ×100). (d) Immunohistochemistry staining (IHC, ×200) showing strong nuclear staining of tumor cells with GATA3 marker that is characteristic of breast carcinoma. (e) Negative staining of meningioma cells (left) compared to metastatic breast carcinoma (right) with GATA3 markers (IHC, ×100). (f) Strong positive staining of breast carcinoma cells with estrogen receptor (ER) marker (IHC, ×200). (g) Negative reaction of meningioma cells with ER marker (IHC, ×100). (h) Focal nuclear staining of both tumor cells with progesterone receptor marker (IHC, ×400).

Meningioma is the most common benign tumor hosting tumor-to-tumor metastases.[17] Various predisposing factors make meningioma a suitable bed for metastases. Increased vascularity and high collagen and fat content combined with low growth rate and metabolic activity provide a fertile yet noncompetitive environment for intratumoral metastases. Furthermore, rich vascularization and the drainage by the dural sinuses facilitate the hematogenous spread into the meningioma. Moreover, conditions such as protection of tumoral tissue from immune surveillance, decreased expression of the tumor suppressor genes, and the existence of cellular and hormonal signaling could potentially play a role in tumor-to-meningioma metastasis.[6,12,14,19]

Tumor-to-tumor metastasis could be mistaken with tumor collision. The phrase "collision tumors" depicts coexistence of two histologically different tumors neighboring in the same organ that invaded each other.[23] In contrast, tumor-to-tumor metastasis is a settled colonizing population of metastatic cells within the interior of the host neoplasm.[4] In this definition, adjacent growth, collision or embolization of the invading neoplasm, and also metastasis to lymph nodes in case of a generalized lymphatic malignancy are not considered as tumor-to-tumor metastasis.[9]

Breast and lung cancers account for the source of 90% of brain and skull base metastasis. The same trend seems to exist for the sources of metastasis to intracranial tumors.[28] Among patients with a known systemic neoplasm, the differential diagnosis of a dural-based intracranial mass mainly involves meningioma, metastatic tumor, secondary malignancy due to cancer therapeutics, and rarely a combination of these. Limitation of routine imaging workups like CT or MRI in differentiation between these possible diagnoses affirms the importance of careful pathological analysis as the tumor-to-tumor metastasis could be missed if the whole tumor is not carefully sampled.[12]

In a review of the literature, Han *et al*. reported that systematic autopsy study of the cases with tumor-to-tumor metastasis usually shows a widely disseminated tumoral involvement in other organs. This is a very important clinical consideration for oncological management of patients with tumor-to-tumor metastasis, even those without an overt disseminated disease.[16]

CONCLUSION

Metastatic carcinoma, either alone or in combination with a primary intracranial tumor, should be suspected when facing intracranial masses among patients with a known history of systemic neoplasm. However, since there may be some overlapping imaging features between skull base meningiomas and some metastatic tumors, it is not always easy to differentiate between the two tumors preoperatively and a more detailed pathological study is needed for appropriate diagnosis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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