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Case Report

Neoplastic cerebral aneurysm from triple-negative breast cancer: A case report

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ABSTRACT

Background: We present a rare case of a ruptured neoplastic aneurysms (NCA) caused by metastatic spread of triple-negative breast cancer (TNBC) in a female patient in her 60s. The patient had a medical history of TNBC and presented to the emergency department after experiencing 3 days of persistent headache.

Case Description: Head computed tomography (CT) revealed a small volume subarachnoid hemorrhage and digital subtraction angiography revealed a 3.9 x 3.5 x 4.2 mm aneurysm or pseudoaneurysm involving the left middle cerebral artery. The aneurysm was successfully clipped and resected, and histopathological examination confirmed triple-negative invasive ductal breast carcinoma within the aneurysm. Six weeks after surgery, she underwent stereotactic radiosurgery and began treatment with chemotherapy. Four months later, the patient presented once again with acute severe headache, and magnetic resonance imaging revealed multiple small lesions within the brain parenchyma, compatible with new metastatic deposits. The patient was subsequently treated with whole-brain radiation therapy and chemotherapy. Over the ensuing 4 months, CT revealed progression of malignancy in the chest, abdomen, and pelvis. Chemotherapy and radiation therapy were terminated, and the patient unfortunately succumbed to her disease 6 months later.

Conclusion: In patients with NCA with poor prognosis due to aggressive brain metastases, treatments that improve quality of life and survival time should be favored.

Keywords: Choriocarcinoma, Metastasis, Neoplastic aneurysm, Subarachnoid hemorrhage, Triple-negative breast cancer

INTRODUCTION

Neoplastic cerebral aneurysms (NCAs) are exceptionally rare lesions caused by tumor cell invasion of the arterial wall, leading to loss of structural integrity and aneurysm formation. The most common cause of NCAs are myxomas of cardiac origin, which are well-characterized in the clinical literature and typically have a good clinical outcome.[12,13] However, rarer etiologies associated with metastatic tumors such as choriocarcinomas and lung cancer have also been reported and typically have a poor prognosis.[13]

Here, we report the course of therapy of a patient with a peripheral NCA of the left middle cerebral artery (MCA). The aneurysm was successfully clipped and resected, which was followed by radiosurgery and chemotherapy; however, she developed multiple additional tumors that

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were treated with chemotherapy and radiation therapy, tolerating the therapies well and living for another 6 months. In patients with NCA and a poor prognosis due to aggressive brain metastases, preference should be given to treatments that improve quality of life and survival time.

CASE REPORT

History and examination

A 60-year-old female experienced an acute onset headache that was temporarily relieved with ibuprofen but presented to the emergency department 3 days later due to headache persistence. It was noted that she had a medical history of triple-negative breast cancer (TNBC) and ST-segment elevation myocardial infarction, as well as a family history of lung cancer and thyroid cancer. Head computed tomography (CT) revealed a small volume subarachnoid hemorrhage within the sulci overlying the posterior left cerebral convexity [Figure 1a]. Digital subtraction angiography (DSA) revealed a 3.9 × 3.5 × 4.2 mm aneurysm or pseudoaneurysm involving a bifurcation point of a distal M4 segment of the left MCA [Figure 1b and c]. Mild stenosis of the distal parent vessel and branch vessel origins was also noted.

Intervention

Embolization through distal navigation was attempted with a Headway® DUO microcatheter over a Synchro[2]® Soft microwire. However, due to the distal location, navigation was ultimately unsuccessful. Surgical clipping with intraoperative DSA guidance was then performed. The aneurysm was successfully clipped and resected, and the sample was sent for histopathology [Figure 1d and e]. A postoperative CT scan of the head demonstrated expected postoperative changes involving the parietal lobe [Figure 1f]. Histopathological examination of the aneurysm sample confirmed triple-negative invasive ductal breast carcinoma [Figure 2]. After surgery, the patient remained neurologically intact. Six weeks after surgery, she underwent CyberKnife stereotactic radiosurgery to the region of the resected aneurysm and began treatment with chemotherapy.

Postoperative course

Four months later, the patient presented once again with acute severe headache. Magnetic resonance imaging revealed multiple small lesions within the brain parenchyma, compatible with new metastatic deposits. Catheter angiography showed bilateral cerebral aneurysms, including a new mixed fusiform and saccular pseudoaneurysm arising from a distal M3 posterior division branch of the right MCA. In addition, there was a mixed fusiform and saccular pseudoaneurysm arising from a distal branch of the left callosomarginal artery with a saccular component measuring up to 2 mm in maximum dimension [Figure 3a and b], as well as a 1 mm saccular outpouching arising from a distal M2 anterior division branch of the right MCA, suspicious for an additional small pseudoaneurysm [Figure 3c].

Given the patient's medical condition, these aneurysms were not felt to be amenable to open surgical repair, and

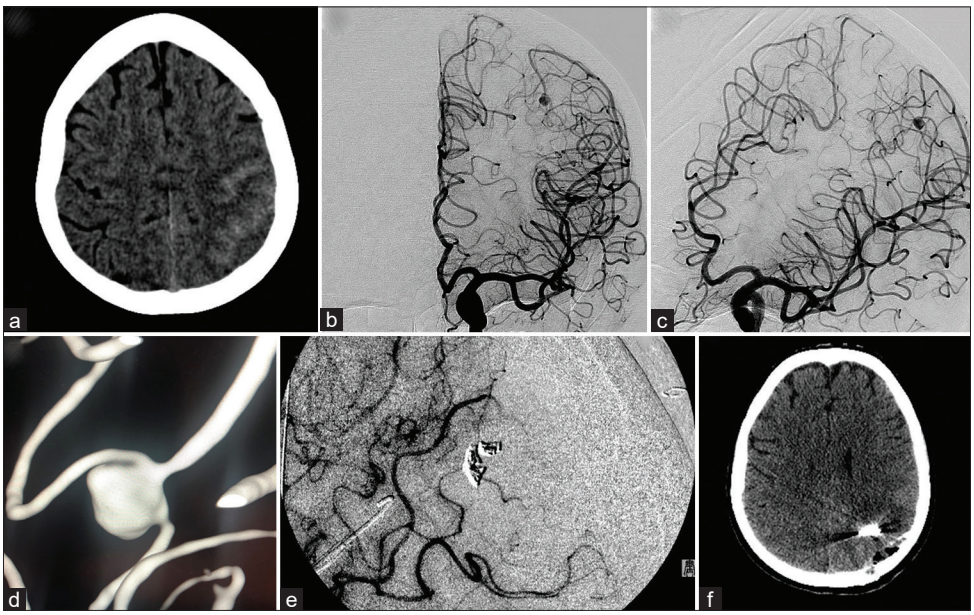

Figure 1: Preoperative, intraoperative, and postoperative imaging. (a) Head computed tomography (CT) at presentation indicating subarachnoid hemorrhage, (b) preoperative angiogram (anteroposterior view), (c) preoperative angiogram (oblique view), (d) preoperative 3D angiography of the neoplastic aneurysm, (e) intraoperative angiogram, (f) postoperative head CT.

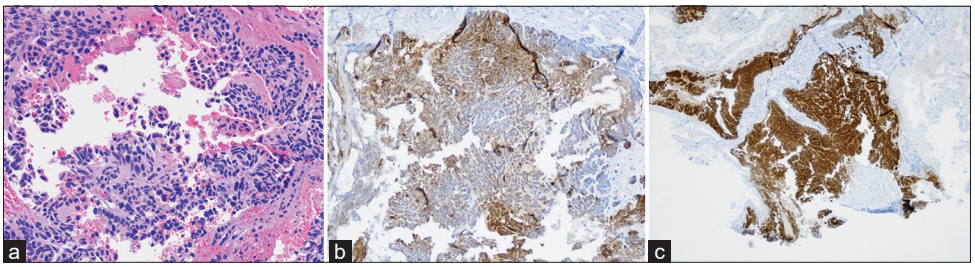

Figure 2: Pathology images. (a) Hematoxylin and eosin staining demonstrating a vessel with tumor cells within the lumen and wall, (b) immunohistochemical stain for cytokeratin AE1/AE3, demonstrating positivity in the tumor cells, (c) immunohistochemical stain showing positivity for Sox10, characteristic of triple-negative breast cancer.

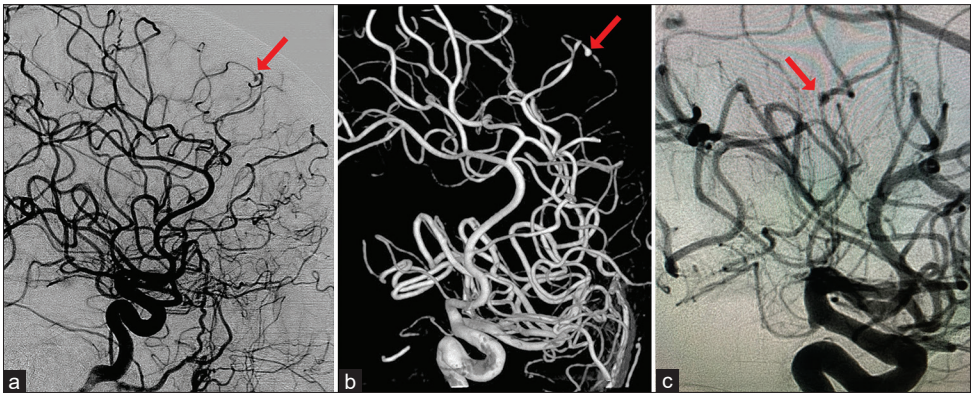

Figure 3: Follow-up radiographic imaging. (a) Digital subtraction angiography (DSA) of a new pseudoaneurysm arising from a distal branch of the left callosomarginal artery (red arrow), (b) 3D DSA of the aneurysm (red arrow), (c) DSA of small pseudoaneurysm arising from a distal M2 anterior division branch of the right middle cerebral artery (red arrow).

endovascular therapy would have required parent artery sacrifice with associated risk of stroke. The patient was seen by an oncologist and radiation oncologist, and it was suggested by the team that there was a chance the aneurysms would be responsive to radiation therapy. The patient was subsequently treated with whole-brain radiation therapy and chemotherapy with capecitabine (Xeloda®). Radiation was well-tolerated other than headaches and fatigue, although the patient was capable of limited self-care and confined to a bed or chair >50% of waking hours. A short-term follow-up DSA was recommended to be sure that there was no unexpected, dramatic enlargement or change in configuration of the lesions. Although a nonsurgical course had been chosen, given the paucity of data regarding these unusual aneurysms, we felt that it was important to be able to modify our recommendations to the family if a significant change had occurred, potentially indicating a very high risk of imminent bleeding. Follow-up cerebral angiography 6 days after initiation of radiation therapy demonstrated interval decreased size of the right MCA posterior division distal M3 segment aneurysm.

Over the ensuing 4 months, CT revealed progression of malignancy in the chest, abdomen, and pelvis. Termination of chemotherapy and radiation therapy was decided, and the patient was offered palliative care. She was placed on a tapering schedule of dexamethasone (Decadron®) to control inflammation and the anticonvulsant medication levetiracetam (Keppra®). The patient died 6 months later while receiving palliative treatment.

DISCUSSION

The present case involved a rare example of a ruptured NCA caused by metastatic spread of TNBC, which is the only case to our knowledge of multiple metachronous NCAs developing in this setting. Only one other case of NCA caused by breast cancer has been published, which was recently reported by Koga *et al*.[2] This case involved a 48-year-old female with pT3pN2M0 breast cancer dissemination within the distal MCA. The patient was treated by cerebral artery bypass and aneurysmal trapping, but postoperative neurological outcome was poor (modified Rankin scale score of 4). Whole-brain radiation and endocrine therapy were initiated for cancer management, but the patient died 78 days later due to progression of leptomeningeal carcinomatosis.

Although treatment of our patient's first aneurysm was "successful," at the time of representation with multiple aneurysms and new brain metastases, the patient's poor

prognosis precluded additional surgical therapy. Our patient also demonstrated rapid progression of disease with diffuse metastatic deposits at 4-month follow-up, making it difficult to justify aggressive surgical intervention. Whole-brain radiation therapy and chemotherapy were well-tolerated with minimal side effects, but her treatment was terminated due to her poor prognosis. It is interesting to note that the largest of her aneurysms demonstrated rapid decrease in size after the initiation of radiation therapy, but this could have been related to local spasm or thrombosis. Nevertheless, the true natural history of these lesions is poorly defined, and it is possible that conservative management, possibly including radiation therapy, might provide adequate control for these lesions. It is worth noting that our patient did not rebleed from her aneurysm during the limited follow-up period.

Although NCAs from breast cancer are exceptionally rare, breast cancer is considered the second most common cause of brain metastasis after lung cancer[9] and TNBC is the most common cause of brain metastasis of breast cancer subtypes,[1,7] occurring in up to 46% of TNBC patients.[4] Brain metastasis from breast cancer is typically a late event in the course of cancer progression and is associated with poor prognosis, with a median survival time of only 4.6 months.[11] Intracranial seeding of TNBC is also almost invariably associated with extracranial metastases,[5,8] as was noted in the current case. Treatment options for intracerebral seeding of breast cancer are also very limited with unclear evidence regarding optimal treatment options. A combination of surgery, chemotherapy, and radiation is an important treatment option in patients with single or few brain lesions,[3,10] but conservative management without surgery is advised in breast cancer patients with diffuse intracranial metastases.[6] Whole-brain radiation therapy is also recommended over stereotactic radiosurgery in breast cancer patients with multiple, nonlocalized brain metastases.[3,6] As such, the treatment strategy for our patient was based on current standards in management of breast cancer patients with multiple brain metastases. Nevertheless, further research is required to identify optimal treatment options that improve both survival and quality of life in NCA patients with breast cancer metastases.

CONCLUSION

We report the second case of an NCA caused by metastatic breast cancer and the only case of multiple metachronous aneurysms developing in this setting. While NCAs are most commonly caused by myxomas and typically have good outcomes, those caused by systemic malignancy such as TNBC have a very poor prognosis. In NCA patients with aggressive brain metastases, surgical resection may not be justified and treatments that improve quality of life and survival time are encouraged. Radiation and chemotherapy without resection can be safely provided in NCA patients with poor prognosis, avoiding the adverse sequelae related to surgical intervention.

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Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

JP is employed by and has ownership interest in Superior Medical Experts. The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

REFERENCES

1. Jin J, Gao Y, Zhang J, Wang L, Wang B, Cao J, *et al*. Incidence, pattern and prognosis of brain metastases in patients with metastatic triple negative breast cancer. BMC Cancer 2018;18:446.
2. Koga M, Aoki T, Negoto T, Makizono T, Sugi K, Fujimori K, *et al*. Leptomeningeal carcinomatosis after neoplastic cerebral aneurysm rupture. World Neurosurg 2019;126:281-4.
3. Leone JP, Leone BA. Breast cancer brain metastases: The last frontier. Exp Hematol Oncol 2015;4:33.
4. Lin NU, Claus E, Sohl J, Razzak AR, Arnaout A, Winer EP. Sites of distant recurrence and clinical outcomes in patients with metastatic triple-negative breast cancer: High incidence of central nervous system metastases. Cancer 2008;113:2638-45.
5. Martin AM, Cagney DN, Catalano PJ, Warren LE, Bellon JR, Punglia RS, *et al*. Brain metastases in newly diagnosed breast cancer: A population-based study. JAMA Oncol 2017;3:1069-77.
6. Mills MN, Figura NB, Arrington JA, Yu HM, Etame AB, Vogelbaum MA, *et al*. Management of brain metastases in breast cancer: A review of current practices and emerging treatments. Breast Cancer Res Treat 2020;180:279-300.
7. Nam BH, Kim SY, Han HS, Kwon Y, Lee KS, Kim TH, *et al*. Breast cancer subtypes and survival in patients with brain metastases. Breast Cancer Res 2008;10:R20.
8. Pedrosa R, Mustafa DA, Soffietti R, Kros JM. Breast cancer brain metastasis: Molecular mechanisms and directions for treatment. Neuro Oncol 2018;20:1439-49.
9. Rick JW, Shahin M, Chandra A, Dalle Ore C, Yue JK, Nguyen A, *et al*. Systemic therapy for brain metastases. Crit Rev Oncol Hematol 2019;142:44-50.
10. Willett A, Wilkinson JB, Shah C, Mehta MP. Management

of solitary and multiple brain metastases from breast cancer. Indian J Med Paediatr Oncol 2015;36:87-93.
11. Witzel I, Laakmann E, Weide R, Neunhöffer T, Park-Simon TJ, Schmidt M, *et al*. Treatment and outcomes of patients in the brain metastases in breast cancer network registry. Eur J Cancer 2018;102:1-9.
12. Xu Q, Zhang X, Wu P, Wang M, Zhou Y, Feng Y. Multiple intracranial aneurysms followed left atrial myxoma: Case report and literature review. J Thorac Dis 2013;5:E227-31.
13. Zheng J, Zhang J. Neoplastic cerebral aneurysm from metastatic tumor: A systematic review of clinical and treatment characteristics. Clin Neurol Neurosurg 2015;128:107-11.

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