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Case Report

A rare case of solitary, isolated dural metastasis from hepatocellular carcinoma mimicking a meningioma

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ABSTRACT

Background: Distinguishing an isolated metastatic dural tumor from a meningioma on imaging is challenging and may lead to a delay in treatment. Here, we present the first known case of isolated, solitary dural metastasis from hepatocellular carcinoma (HCC) mimicking a meningioma.

Case Description: A 64-year-old male with a history of liver cirrhosis presented with a 5.8 cm enhancing left parafalcine hemorrhagic dural-based mass extending across the midline. Cerebral angiography revealed a distal left anterior pseudoaneurysm, and tumor contrast blush with feeders from the left ophthalmic and right middle meningeal artery. The pseudoaneurysm was successfully embolized to stop the bleeding, followed by an uneventful bi-coronal frontal craniotomy for falcine tumor resection to relieve brain compression. Histopathological analysis of the dural-based tumor showed poorly differentiated carcinoma with positive albumin *in situ* hybridization and cytokeratin tumor markers, consistent with dural metastases from HCC.

Conclusion: When encountering a solitary, highly vascular mass bearing resemblance to a meningioma, it may be prudent to consider the possibility of a dural-based metastatic carcinoma.

Keywords: Dural metastasis, Hepatocellular carcinoma, Meningioma

INTRODUCTION

With advancements in systemic treatments that have prolonged survival times in patients with late-stage malignancies, there has been a growing body of literature demonstrating cancer metastases to previously uncommon sites. Among them include metastases to the brain dura mater, which are rare, late manifestations of solid tumors that often portend poor prognoses.[3]

To date, reported cases of isolated dural metastasis have been limited to patients with primary malignancies of the lung, breast, or prostate; dural extension from hepatocellular carcinoma (HCC) has yet to be described.[11] Diagnosis of isolated dural metastasis is challenging given the considerable overlap in imaging features with meningiomas, which are common, extra-axial primary brain tumors that are usually benign.[11] Here, we report the first known case of a patient with isolated, solitary dural metastasis of HCC mimicking a meningioma.

CASE DESCRIPTION

A 64-year-old male presented to the emergency department from his care home with 12 days of dysarthria and right hemiparesis and three days of progressively worsening altered mental status. His medical history was significant for homelessness, chronic hepatitis C, liver cirrhosis, polysubstance use disorder, and schizoaffective disorder. Of note, an incidental abdominal and pelvic computed tomography (CT) scan for a urinary tract infection obtained one year before admission was negative for any liver masses.

The patient's initial examination was notable for the left gaze preference, global aphasia, and right hemiparesis, with head CT showing a large hypervascular 5.7 cm tumor with surrounding edema [Figure 1a]. He was subsequently intubated for hypoxemic respiratory failure and admitted to the neuroscience intensive care unit. Brain magnetic resonance imaging (MRI) revealed a 5.8 cm enhancing left dural parafalcine hemorrhagic mass extending across the midline with significant vasogenic edema [Figures 1b-d]. The radiographic differential diagnosis included a hemorrhagic meningioma versus meningeal hemangiopericytoma. A diagnostic cerebral angiogram demonstrated a distal left anterior cerebral artery (ACA) pseudoaneurysm within the hemorrhagic mass, with additional inputs from the left ophthalmic artery and right middle meningeal artery [Figures 2a-c]. The patient underwent successful endovascular embolization of the pseudoaneurysm, which was deemed the source of hemorrhage [Figure 2d]. Given evidence of pronounced mass effect seen on initial imaging, neurosurgical evaluation recommended resection of the tumor to optimize his recovery potential. Following a discussion with the family, who agreed with said recommendations, the patient underwent an uncomplicated bicoronal frontal craniotomy for falcine tumor resection [Figures 3a and b]. The intraoperative frozen section of the tumor sample was sent to pathology and was initially interpreted as meningioma. On subsequent examination, however, the tumor sample was negative for numerous other meningioma markers, challenging the preliminary diagnosis. The samples were, thus, sent to another institution for a second consultation.

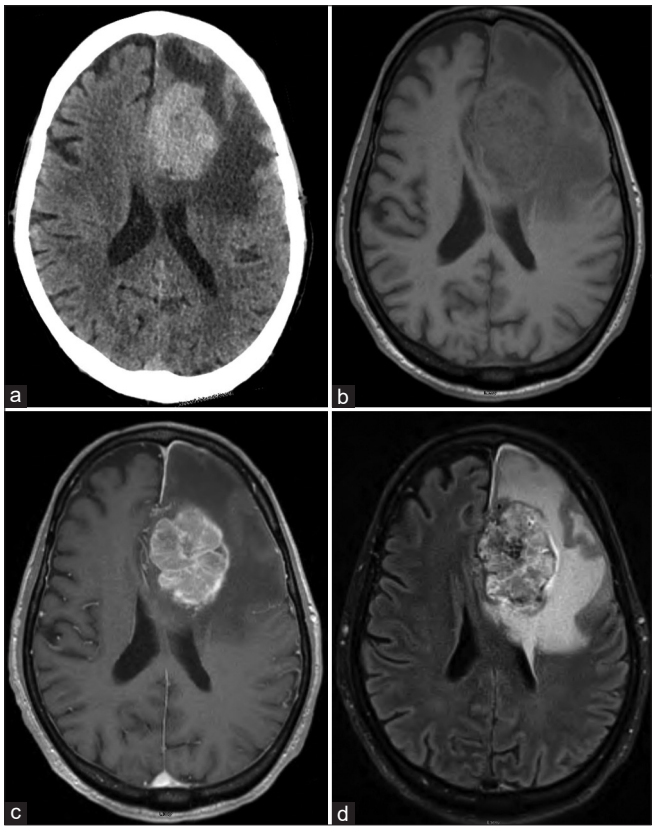

Figure 1: (a) Initial head CT showing a 5.7 cm left frontal hypervascular tumor with significant edema. (b) Pre- and (c) post-contrast T1-weighted MRI showing a 5.8 cm enhancing extra-axial left parafalcine hemorrhagic mass crossing midline. (d) T2-FLAIR MRI shows extensive surrounding vasogenic edema. CT: Computed tomography, MRI: Magnetic resonance imaging, FLAIR: Fluid-attenuated inversion recovery.

The patient's postoperative course was complicated by persistent neurologic disability, *Klebsiella pneumoniae* and Methicillin-sensitive *Staphylococcus aureus* pneumonia, and prolonged ventilator dependence. Given his advanced disease, the patient was transitioned to comfort measures following a discussion with the family and expired on day 18 of hospitalization. Histopathological findings of the dural-based tumor returned following the patient's passing, revealing a poorly differentiated carcinoma with positive epithelial markers and *in situ* hybridization staining for albumin [Figures 4a-e]. These findings, in the context of the patient's underlying liver cirrhosis, were consistent with metastatic HCC.

DISCUSSION

Intra- and extra-axial brain metastasis are very rare manifestations of HCC, with an estimated incidence of 0.3–2.2%.[1] HCC initially spreads contiguously through the portal and hepatic veins, followed by the regional lymph nodes.[1] Intravasation into the veins subsequently leads to pulmonary vascular metastasis into the lungs, the most common extrahepatic metastatic site, followed by the bones and adrenal glands.[14] The brain is hypothesized to be the next most common site of HCC metastasis.[10]

Several hypothesized mechanisms detail how tumor seeding of the dura mater may occur. One such route involves direct extension from existing calvarial metastases to the dura, most commonly in breast and prostate cancer.[5,7,9] This was unlikely in our patient as there was no radiographic evidence

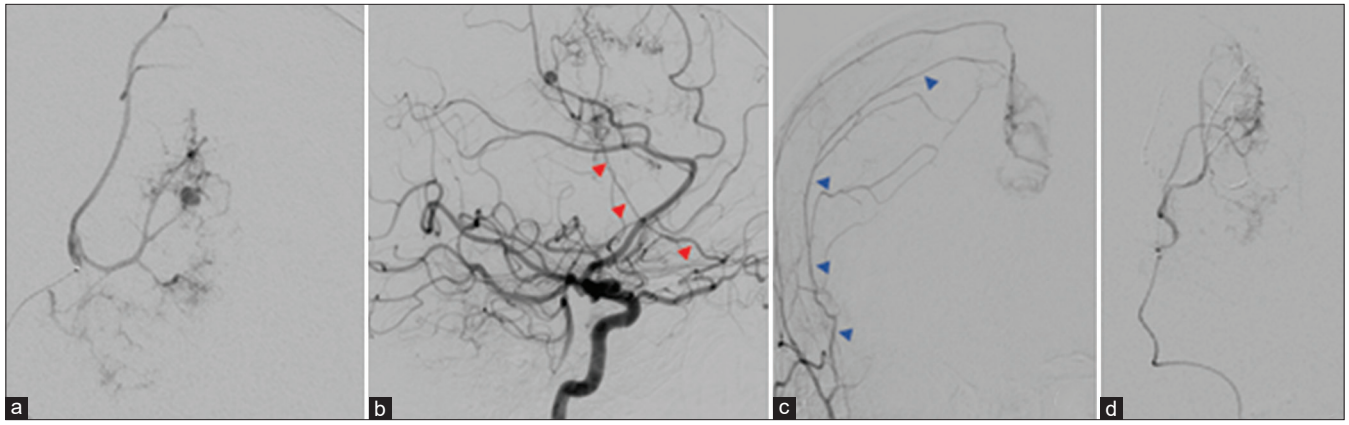

Figure 2: Cerebral angiography showing (a) left ACA pseudoaneurysm, and tumor contrast blush with additional supply from the (b) left meningeal branch of the left ophthalmic artery (red arrows) and the (c) right middle meningeal artery (blue arrows). (d) Post-embolization of the ACA pseudoaneurysm. ACA: Anterior cerebral artery.

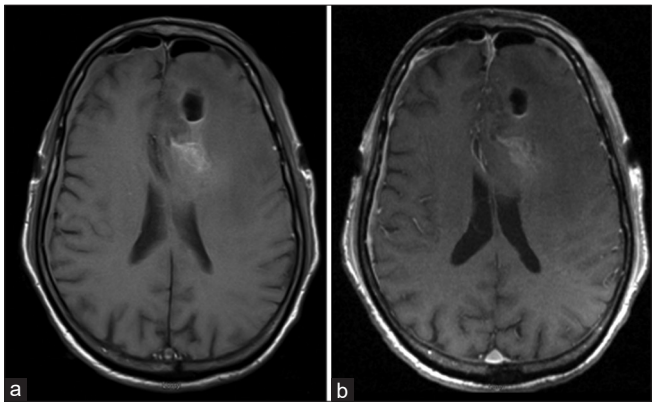

Figure 3: Postoperative (a) pre- and (b) post-contrast T1-weighted MRI with no evidence of residual enhancing tumor. MRI: Magnetic resonance imaging.

of bony metastases or dural venous sinus involvement.[5,7] In the absence of calvarium metastases, a more probable mechanism is direct hematogenous spread to the dura mater.[7] This theory is supported by postmortem studies of patients with dural metastases, which showed evidence of substantial vascular tumor burden, particularly in those with concomitant lung involvement.[5,7] Hematogenous metastases to the brain parenchyma, meninges, and cranium are thought to occur along a middle cerebral artery (MCA) distribution.[6] The reason for this is unknown; however, a possible explanation is the higher blood flow rate in the MCA territories compared to the ACA and posterior cerebral artery distributions. In our case, the dural mass was located in the left parafalcine region, with blood supply predominantly fed by the ACA. We are, however unable to determine if the metastasis occurred spontaneously or if there was a pre-existing meningioma in the region that predisposed metastasized cancer cells to accumulate within it, akin to the tumor-to-tumor phenomenon.[2] Indeed, there have been reports of primary solid organ neoplasms directly metastasizing to meningiomas.[2,13] Within meningiomas are rich vascular supplies, lack of a host immune response, and significant collagen and lipid content, all of which contribute to an optimal tumor microenvironment and thus predispose tumor cell seeding to this region.[2]

Diagnosis of dural metastatic carcinoma is challenging as they are both clinically and radiographically difficult to distinguish from meningiomas.[11,13] Akin to meningiomas, symptoms of dural metastases are often clinically silent, producing symptoms primarily from significant mass effect or from spread to the underlying brain parenchyma.[7] Rarely, dural metastases may present as an acute epidural or subdural hematoma.[10,15] Of interest, chronic subdural hematomas have been noted to be present in 15–40% of dural metastasis cases, possibly from rupture of unstable tumor vessels from angiogenesis.[7] Imaging of dural metastases is often obtained late, as they are found either incidentally or on severe symptomatic presentation. On MRI, both dural metastases and meningiomas may present as contrast-enhancing, homogeneous lesions with a dural tail sign and vasogenic edema.[7] Perfusion-weighted imaging of dural metastases may show lower relative cerebral blood volume than meningiomas, though studies have yielded inconsistent results.[8] Angiographic findings are also nonspecific, as both meningiomas and dural metastases may present as highly vascular tumors with prominent tumor contrast blush.[4,12] In the setting of equivocal imaging findings, magnetic resonance spectroscopy may be used to detect elevated alanine peaks in meningiomas that are not typically present in cerebral metastases.[13] Although meningiomas are by far the most common primary brain tumors, other radiographic differential diagnoses to consider include hemangiopericytomas, leiomyosarcomas, or solitary fibrous tumors.[11]

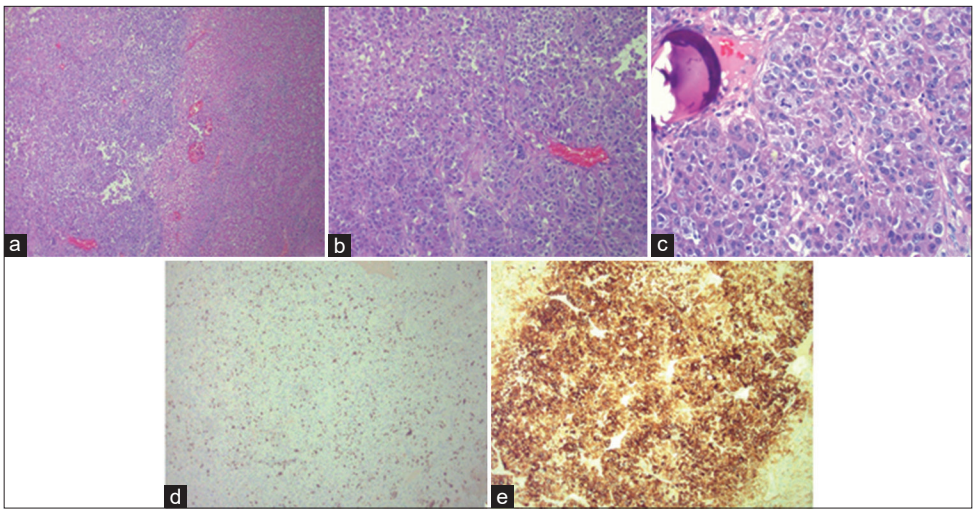

Figure 4: Prepared slides of the dural-based tumor stained with hematoxylin and eosin showing (a) viable tumor (left) and necrotic tumor (right), (b) cohesive nests of tumor cells with a fair amount of eosinophilic cytoplasm, and (c) atypical tumor cells with brisk mitotic activity, nuclear pleomorphism, and prominent nucleoli. Immunohistochemical examination showing (d) markedly elevated ki-67 index of 25%, supporting the malignant nature of the tumor. (e) The tumor was diffusely positive for epithelial markers (cytokeratin AE1/AE3) and negative for hepatocellular markers (HepPar1, glypican 3), though albumin *in situ* hybridization was positive in a large subset of tumor cells. These findings in a patient with a history of liver cirrhosis were consistent with metastatic hepatocellular carcinoma.

CONCLUSION

Solitary, isolated metastasis to the dura mater is a rare manifestation of HCC that is seldom the initial clinical presentation and is imperative to distinguish from a meningioma. When faced with an isolated, hypervascular mass resembling a meningioma, a metastatic tumor should remain on the differential.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

Use of Artificial Intelligence (AI)-Assisted Technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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