Pachymeningeal en plaque metastasis from gastric cancer mimicking subdural hematoma: illustrative case

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BACKGROUND Pachymeningeal metastasis associated with gastric cancer, especially in its early stages, is extremely rare.

OBSERVATIONS The authors describe a 77-year-old man with a past medical history of lung cancer and previously treated chronic subdural hematoma who was admitted to their hospital because of hematemesis and newly diagnosed gastric cancer. He became unconscious during the hospitalization. The preoperative brain imaging studies had the appearance of recurrent subdural hematoma and extracranial tumor with skull invasion. Craniotomy revealed pachymeningeal carcinomatosis and en plaque metastasis of tumor. The histopathology of the tumors was consistent with metastatic gastric adenocarcinoma.

LESSONS This is the first reported case of metastatic gastric cancer as a pachymeninges-based en plaque entity. This report highlights the rare radiological presentation and operative findings in this case. The authors also summarize those case reports associated with dural metastasis arising from gastric cancer.

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KEYWORDS pachymeningeal carcinomatosis; pachymeningeal metastasis; dural metastasis; en plaque lesion; gastric cancer

The most common sites for gastric cancer to metastasize are the liver, peritoneum, lung, and bones.1 Brain metastases from gastric cancer are rare, occurring in less than 1% of patients with gastric cancer, and are most commonly parenchymal leptomeningeal.2,3 Dural metastasis from gastric cancer has been rarely reported.4-13 To our knowledge, this is the first reported case of metastasis of pachymeningeal en plaque tumor from gastric cancer.

Illustrative Case

A 77-year-old man had lung adenocarcinoma pT1a N0 M0 stage IA in the right lower lobe after thoracoscopic segmentectomy in 2016 without recurrence. In March 2021, he presented with progressive right hemiparesis, and noncontrast computed tomography (CT) scanning of the brain revealed a left frontal-parietal-temporal chronic subdural hematoma (SDH) (Fig. 1A and B). After burr hole drainage was performed, the patient’s symptoms improved. In September 2021, the patient was admitted to our hospital because of hematemesis. Upper gastrointestinal pan-endoscopy revealed bleeding from malignant gastric ulcers in the gastric cardia. Hemostasis was achieved, and biopsies were performed. The histopathology of the biopsies showed primary gastric adenocarcinoma. Abdominal CT showed staging of T3 N0 M0. The patient developed consciousness disturbance during the hospitalization. A noncontrast CT scan of the brain showed some subdural fluid accumulation and a skull-penetrating soft tissue mass (3.5 x 3.0 cm) that had developed in the left frontal bone, the location distant from the previous burr hole drainage (Fig. 1C and D). Gadolinium-enhanced brain magnetic resonance imaging (MRI) showed enhancement of the soft tissue mass and the presence of pachymeninges and a subdural lesion (Fig. 2). Subsequently, a craniotomy was performed. The soft tissue tumor was found to be destructing the frontal bone, penetrating

ABBREVIATIONS CT = computed tomography; MRI = magnetic resonance imaging; SDH = subdural hematoma.

ASSOCIATED CONTENT

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the dura mater, and connecting to the subdural lesion (Fig. 3A and B). The infiltration of tumor cells in the dura mater was noted. After the dura was opened, no SDH was found. However, we did find a diffuse, fleshy, thick en plaque subdural tumor extending to the edges of the frontal, parietal, and temporal bones (Fig. 3C). The bottom of the tumors was a neomembrane adjacent to the subarachnoid membrane, which required careful dissection (Fig. 3D). Maximum subtotal resection of the tumor was performed. Immunohistochemical staining using antibodies against thyroid transcription factor 1 (TTF-1), CK5/6, CK7, CK19, CK20, epithelial membrane antigen (EMA), CDX-2, prostate-specific antigen, thyroglobulin, glial fibrillary acidic protein, GATA-3, uroplakin, vimentin, S100, and p63 was performed. The tumor cells were immunoreactive against antibodies to EMA and CK19 but not immunoreactive against other antibodies (Fig. 4). The immunoprofile confirmed the diagnosis of metastatic adenocarcinoma, originating from the stomach. Although the neurological symptoms of the patient improved after the operation, the patient died 2 days after surgery due to the complication of pulmonary embolism and respiratory failure.

**Patient Informed Consent**

The necessary patient informed consent was obtained in this study.

**Discussion**

**Observations**

The pachymeninges are the dura mater, which comprises 2 fused membranes derived from the embryonic meninx primativa, the periosite of the inner table of the skull, and a meningeal layer. The leptomeninges, also known as “skinny meninges,” are the pia and arachnoid mater. Dural metastases, also known as “pachymeningeal metastases,” can result from the direct spread of metastases in the skull or hematogenous spread. The most commonly reported neoplasms associated with dural metastases are breast, prostate, and lung cancers. Gastric cancer with dural metastases is relatively rare. Although our patient had a history of lung cancer and the abdominal CT scan showed no regional lymph nodes or distant metastases, he had adenocarcinoma of gastric origin. The metastatic behavior of cardia cancer is completely distinct from that of non-cardia cancer, with metastases spreading more to the lungs, bones, and nervous system but less within the peritoneum. Our patient’s gastric cancer developed in the cardia region. The lymphatic and hematogenous extension of early gastric cancer may result from the infiltration of malignant cells to the lymphatic and vascular drainage routes in the mucosal and submucosal layers.
Dural metastases are always clinically silent and are discovered during radiological workup, autopsy, or surgical intervention. Although SDHs are common among patients, the accumulation of subdural fluid is not always severe enough to cause symptoms. Our patient had a history of chronic SDH 6 months before the diagnosis of gastric cancer with brain metastases. He did not have a history of trauma and did not use antplatelets or anticoagulants. He was treated as a regular patient with chronic SDH, and his symptoms improved. We suspected that the chronic SDH might have been the earliest sign of the dural metastases. However, we had no pathological evidence or MRI findings. Kunii et al. analyzed 51 reported cases of SDH and found that the most common histological type of SDH was adenocarcinoma and the most common primary tumor site was the stomach. We recommend that all collected subdural fluids be sent for pathological analysis, particularly in patients with a history of cancer.

Although dural metastases from adenocarcinoma are not uncommon, dural metastases with an en plaque presentation is rare. Kapoo et al. and Jasmit et al. have reported cases of dural metastases.

**TABLE 1. Summary of the cases associated with dural metastasis arising from gastric cancer**

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs), Sex</th>
<th>Image Findings</th>
<th>Histological Diagnosis</th>
<th>Presentation</th>
<th>Treatment</th>
<th>Outcome (Survival Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kunii et al. 2005</td>
<td>56, F</td>
<td>Rt subdural hematoma</td>
<td>Adenocarcinoma</td>
<td>Decline in consciousness, hemiparesis</td>
<td>Craniotomy, whole-brain radiotherapy</td>
<td>No mention</td>
</tr>
<tr>
<td>Katsube et al. 2007</td>
<td>60, F; 73, M</td>
<td>Lt subdural hematoma; rt subdural hematoma</td>
<td>Adenocarcinoma; adenocarcinoma, por2, &amp; a scirrhous type</td>
<td>Consciousness change &amp; hemiplegic; lightheadedness &amp; a mildly decreased level of consciousness</td>
<td>Burr hole &amp; biopsy; burr hole &amp; biopsy</td>
<td>Died postoperative day 13; died postoperative day 14</td>
</tr>
<tr>
<td>Misadeghi et al. 2008</td>
<td>44, F</td>
<td>Rt subdural effusion</td>
<td>Adenocarcinoma</td>
<td>HA, dyspahisa, worsened hemiparesis</td>
<td>Burr hole, craniotomy</td>
<td>Died from pulmonary insufficiency</td>
</tr>
<tr>
<td>Kuan-Yin et al. 2011</td>
<td>52, M</td>
<td>Rt chronic subdural hematoma</td>
<td>Adenocarcinoma, signet ring cell differentiation</td>
<td>HA, dizziness, lt lower limb weakness</td>
<td>Burr hole, craniotomy</td>
<td>Died postoperative day 14</td>
</tr>
<tr>
<td>Kimura et al. 2013</td>
<td>63, F</td>
<td>Solid tumor projected into subdural space &amp; rt subdural effusion</td>
<td>Adenocarcinoma</td>
<td>HA &amp; vomiting</td>
<td>Burr hole, craniotomy</td>
<td>Died day 78 after hospitalization</td>
</tr>
<tr>
<td>Yuan et al. 2014</td>
<td>55, F</td>
<td>Rt chronic subdural hematoma</td>
<td>Adenocarcinoma</td>
<td>Sudden deteriorate in consciousness</td>
<td>Craniectomy</td>
<td>Alive at 4-mo FU</td>
</tr>
<tr>
<td>Kim et al. 2018</td>
<td>43, F</td>
<td>LS–S1 dura metastasis w/ root compression &amp; Lt CP angle w/ invasion to IAC</td>
<td>Adenocarcinoma</td>
<td>Back pain, rt radiating leg pain, lt facial palsy, &amp; hearing loss</td>
<td>Radiotherapy</td>
<td>Died 10 mos after diagnosis of dura metastasis</td>
</tr>
<tr>
<td>Cioni et al. 2020</td>
<td>39, F</td>
<td>Dural neoplastic involvement w/o subdural hematoma</td>
<td>Adenocarcinoma</td>
<td>Confusion &amp; HA</td>
<td>Palliative treatment w/ intrathecal chemo</td>
<td>Died 16 days after admission</td>
</tr>
<tr>
<td>Zhao et al. 2021</td>
<td>45, F</td>
<td>Huge EDH at temporal &amp; parietal region</td>
<td>Poorly differentiated adenocarcinoma</td>
<td>Sudden-onset HA, loss of consciousness</td>
<td>Craniotomy</td>
<td>Died 1 mo after op</td>
</tr>
<tr>
<td>Ortega Rodríguez et al. 2021</td>
<td>39, F</td>
<td>Acute bleeding w/in subdural fusion</td>
<td>Adenocarcinoma</td>
<td>Consciousness deterioration &amp; hemiparesis</td>
<td>Craniotomy</td>
<td>Died 2 days after op due to rebleeding</td>
</tr>
<tr>
<td>Present case</td>
<td>77, M</td>
<td>Enhancement of bony destructive tumor, pachymeninges, &amp; subdural lesion</td>
<td>Adenocarcinoma</td>
<td>Progressive rt hemiparesis &amp; consciousness disturbance</td>
<td>Craniotomy</td>
<td>Died 2 days after op (pulmonary embolism)</td>
</tr>
</tbody>
</table>

CP = cerebellopontine; EDH = epidural hematoma; FU = follow-up; HA = headache; op = operation; por2 = non–solid-type poorly differentiated adenocarcinoma; IAC = internal acoustic canal.
metastases from lung adenocarcinoma with an en plaque meningiomia. Our patient had an en plaque dural lesion, which was suspected to be recurrent SDH. Gadolinium-enhanced MRI is the optimal imaging technique used for the diagnosis of suspected cerebral metastases. On MRI, dural metastases may present as a solitary lesion or appear as linear dural thickening or nodular focal or diffuse lesions. Metastatic dural lesions actively manifest in the T1-weighted phase with contrast, reflecting their vascular nature and the absence of a blood–brain barrier. However, subacute SDH or recurrent bleeding in chronic SDH can appear incomparable to that on T1 MRI, which is difficult to distinguish from dural metastases. Because the soft tissue mass was found to be destructing the bones of our patient, we performed craniotomy over a relatively large area.

Our case differs from previously reported cases of gastric adenocarcinoma with metastases (Table 1). First, the original SDH was a pachymeningeal en plaque tumor. We hypothesize that cancer cell metastasis can occur through direct invasion of a previous surgical wound, such as an open dura. Second, studies have not demonstrated the surgical specimens of pachymeningeal en plaque metastases from gastric adenocarcinoma. According to our review of the literature, this is the first reported case of gastric adenocarcinoma that metastasized to the pachymeninges with en plaque presentation and appearing as a subdural hematoma.

The prognosis for patients with gastric cancer with pachymeningeal metastases is generally poor. Riihimäki et al. revealed that the median survival rate for patients with metastatic gastric cancer is 3 months, which is the shortest time compared with patients with bone and liver metastases (i.e., 2 mo). Previous studies have demonstrated that the survival rate of patients with dural metastases from gastric adenocarcinoma is comparable primarily because of the progression of the systemic disease and metastatic spread in patients with gastric cancer.

Lessons
This is the first reported case of pachymeningeal en plaque metastases from gastric adenocarcinoma. The clinical characteristics and MRI results can be misleading in the diagnosis of the SDH, meningiomia, and metastatic tumors arising from other common origins. The prognosis for pachymeningeal en plaque metastases from gastric adenocarcinoma is poor. Thus, clinicians, radiologists, and pathologists should be careful when confirming the diagnosis.

References

Disclosures
The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions
Conception and design: Tsai, HY Wu, Lam, Kuan. Acquisition of data: Lam, Kuan, Chen, CS Wu. Analysis and interpretation of data: HY Wu, Lam, Kuan, Chen, CS Wu. Drafting of the article: HY Wu, Lam, Kuan, CS Wu. Critically revising the article: Tsai, HY Wu, Lam. Reviewed submitted version of the manuscript: Tsai, HY Wu, Lam, Kuan. Approved the final version of the manuscript on behalf of all authors: Tsai.

Statistical analysis: Lam. Administrative/technical/material support: Lam. Study supervision: Tsai, Lam.

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