

CASE REPORT

Calvarium penetration from intracranial metastasis of pulmonary small cell carcinoma

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ABSTRACT

Small cell lung carcinoma (SCLC) comprises approximately 10-15% of diagnosed lung cancers. It is characterized by its rapid growth and metastatic nature, with a majority of diagnoses of SCLC occurring after metastasis. In this case, we present a patient diagnosed with pulmonary small cell lung carcinoma with metastasis to the brain that penetrated through the bony calvarium. After an extensive literature search, the extension of brain metastasis through the skull –originating from a primary lung cancer– has only been identified in two other cases with this being the first documented case of SCLC.

Key words: small cell, metastasis, calvarium

INTRODUCTION

While the incidence of lung cancer has been steadily decreasing in the United States, lung cancer remains the most lethal cancer with higher mortality than other types of cancer.¹ Small cell lung carcinoma (SCLC) comprises approximately 10-15% of diagnosed lung cancers. It is characterized by its rapid growth and metastatic nature, with a majority of diagnoses of SCLC occurring after metastasis. Its propensity to spread quickly often necessitates initial systemic therapy. There are various metastatic sites of SCLC with metastasis to the brain among one of the most widely documented in literature and often with an increased occurrence as length of patient survival increases.² Brain metastasis in patients often occurs through hematogenous spread and represents poor prognosis, with survival of four to seven months despite whole brain radiation therapy - which is the current recommended treatment.³ Approximately 80% of brain metastases are documented in the cerebrum with only a minority demonstrating infiltrative growth pattern.⁴ In this case, we present a patient diagnosed with pulmonary small cell lung carcinoma with metastasis to the brain that penetrated through the bony calvarium. After an extensive literature search, the extension of brain metastasis through the skull –originating from a primary lung cancer– has only been identified in two other cases with this being the first documented case of SCLC.^{5,6}

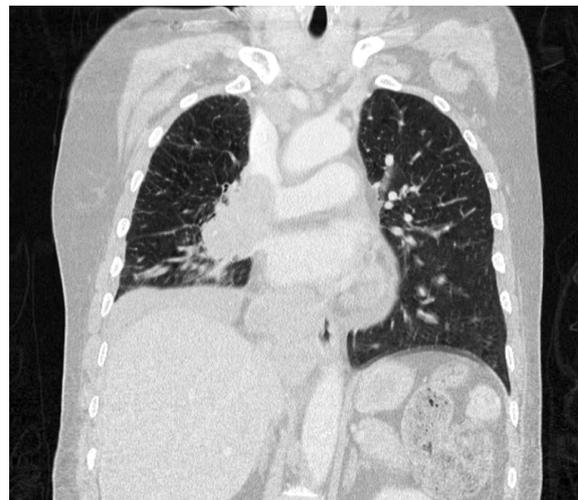


Figure 1, Coronal slice using computed tomography demonstrating right lower lobe mass, with prominent hilar and mediastinal lymphadenopathy, consistent with small cell carcinoma of the lung.

CASE REPORT

The patient is a 60-year-old female, with a past medical history of asthma, emphysema, hypothyroidism, hyperlipidemia, tobacco abuse, and osteoarthritis who presented to her primary care physician with scalp swelling. Originally, the swelling appeared soft and mobile and thus, diagnosed as a lipoma and patient was safely sent home. Several months later, she revisited her primary care physician, as she felt the swelling was gradually becoming firmer. At that time, she was told to follow up with a surgeon to get it excised, and planned to do so after the holiday season. Two months later, she presented to the emergency room with two episodes of slurred speech and facial droop lasting approximately 3-4 minutes per episode. The onset of her symptoms was sudden with the first

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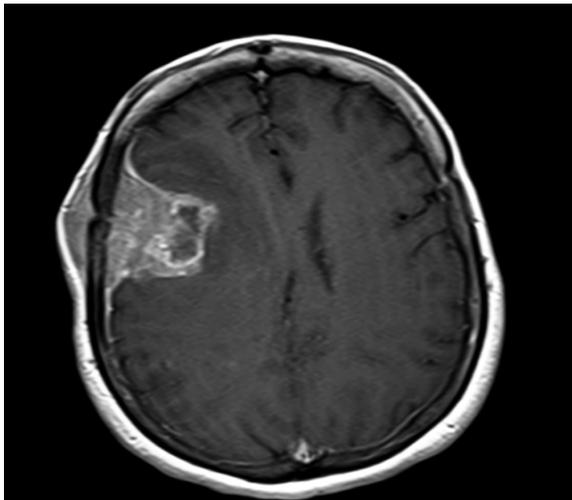


Figure 2, Axial slice using magnetic resonance imaging demonstrating the right parietal intracranial metastases.

episode occurring three hours and the second occurring two hours prior to presentation to the emergency department. In the emergency department, the patient had a seizure episode that was appropriately controlled with medications. At the time of admission, she admitted to left-sided weakness, a six-month history of growing head masses, but denied a history of seizures, headaches, head trauma, neck pain, visual disturbances, vertigo, vomiting, or urinary incontinence. Her family history was significant for a sibling with emphysema and a brother who passed away from an unknown lung cancer. The patient's social history was significant for a 40-pack-year smoking history. Physical examination of the patient revealed a temperature of 97.8 F, blood pressure of 122/71 mmHg, a respiratory rate of 19 breathes per minute, and heart rate of 88 beats per minute. The patient was alert and oriented to person, place, and time with slight slurring speech and left sided facial

muscle weakness. Examination of her head revealed a 0.5 x 4 cm irregular, firm, and immobile mass on the upper right temporal region and a 6 x 6 cm irregular, firm and immobile mass on the left occipital region without ulceration or erythema surrounding the masses. Lungs were clear to auscultation bilaterally but she exhibited poor inspiratory effort.

A CT of the chest with IV contrast showed a large hilar mass with prominent hilar and mediastinal lymphadenopathy (Fig. 1).

A magnetic resonance imaging (MRI) of the head without IV contrast revealed bilateral enhancing dural masses, which measured approximately 3.8 x 3.8 cm in the right parietal region (Fig. 2) and 2.3 x 2.3 cm in the high left posterior parietal region. A smaller enhancing dural lesion was seen in the left occipital lobe measuring 2.8 x 1.2 cm with extension of the mass lesions through the overlying bony calvarium to the scalp.

A right temporal scalp lesion biopsy was performed which showed invasive tumor in fibrous tissue consisting of small highly atypical cells with prominent crush artifact. An immunohistochemical panel of the biopsy was also performed which was positive for synaptophysin and chromogranin A, two neuroendocrine markers suggestive of small cell carcinoma.⁷ A thyroid transcription factor-1 stain (TTF-1) also was revealed to be positive while the cytokeratin 7 (CK7) and cytokeratin 20 (CK20) markers were both negative. The immunohistochemical panel in conjunction with the histology were consistent with metastatic small cell neuroendocrine carcinoma of the lung.⁷ A core lung biopsy of the hilar mass was obtained which showed atypical small cells suspicious for small cell carcinoma of lung.⁷ (Fig. 3)

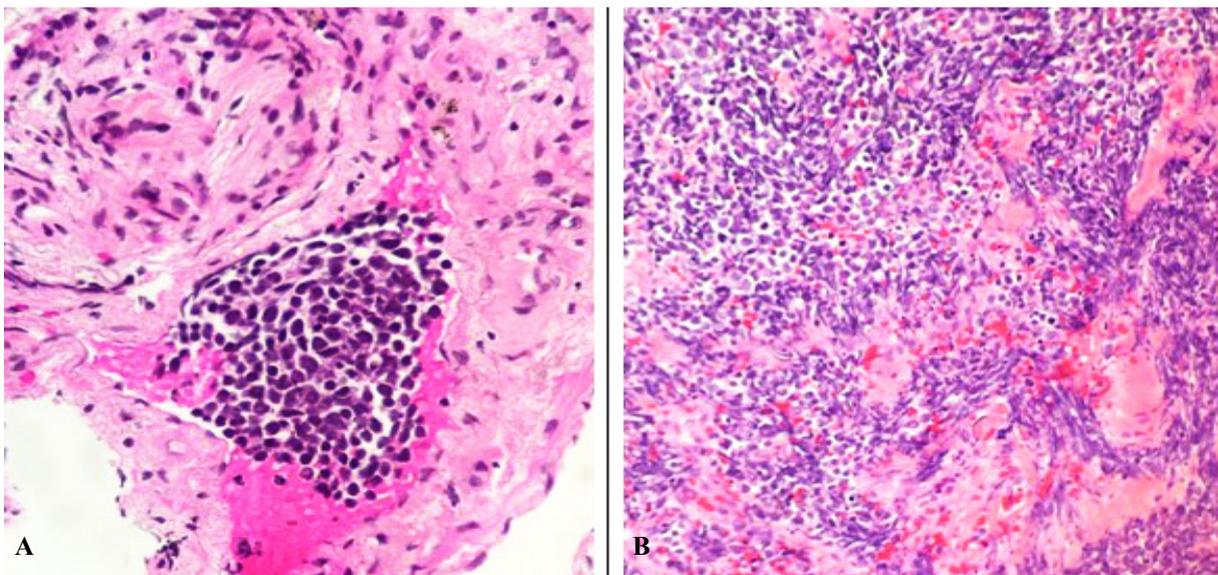


Figure 3, A core lung biopsy exhibiting atypical small cells suspicious for small cell carcinoma of the lung (A) and a temporal scalp lesion biopsy showing invasive tumor in fibrous tissue consisting of small highly atypical cells with prominent crush artifact (B).

DISCUSSION

Through a literature search, there are two other documented cases of primary lung cancers metastasizing to the brain with bony destruction.^{5, 6} In the first case, Kader et al describes a 8.78 × 7.40 × 7.79 cm primary pulmonary squamous cell carcinoma that eroded through the parietal bone while, in the second case, *Foco et al.* reported a 15 cm diameter pulmonary adenocarcinoma that penetrated through the frontal bone.^{5, 6} In the case presented, there were approximately three 2-4 cm diameter metastatic lesions that penetrated through the parietal and occipital calvarium. In the three reported cases, there is a significantly wide range of types, sizes, and locations of metastatic brain tumors that exhibited bony extension.

The tumor sizes ranged from being as small as approximately 2 cm in diameter, as in our case, to 15 cm in diameter in *Foco et al.* The types of lung cancer included squamous, adenomatous, small cell, and finally the areas of bony erosion included parietal, frontal, occipital bones.^{5, 6} The lack of consistency and sparse documented cases make it difficult to speculate on unifying characteristics in metastatic brain lesions with bony penetration. The mechanism of bone tissue invasion by metastatic lesions is not fully understood as cancers often metastasize to the bone rather than invade through it.⁸ Bones are resistant to erosion and often represent a barrier to invasion.⁸ It has been suggested that injuries to the periosteum can cause bone tissue to become more prone to tumor invasion but neither head trauma nor injuries to the calvaria were suggested in this case presented or that of Kader *et al.*^{5, 9} Considering the rare occurrence of penetrating intracranial primary lung cancers, there is little documentation regarding a standard of management. Stereotactic radiosurgery has shown to be an effective therapy for resecting smaller intracranial lesions less than 100 mm³, however, due to the large range of presenting metastases sizes in the three cases reviewed alone, whole brain radiation therapy conceivably still remains the standard of treatment.^{10, 11}

CONCLUSION

Extension of a brain metastasis through the calvarium to the scalp, from a primary lung cancer, is exceedingly rare with this case being the first documented case of the SCLC subtype. Since rare, this presentation can often be overlooked and underlying diagnosis can be delayed, often resulting in further progression of disease state and poorer prognosis, for the patient. The ability to penetrate through the calvarium is a novel and aggressive characteristic of SCLC

and more knowledge of this characteristic should be elucidated, for it may help guide future research and treatment options for SCLC.

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