

Case Report

Radiologic and pathologic correlation of leptomeningeal metastasis presenting as a circumscribed comedo-like bulky mass with minimal brain parenchymal invasion: A case report

Arunnit Boonrod, M.D.⁽¹⁾

Nontaphon Piyawattanametha, M.D.⁽²⁾

Mix Wannasarnmetha, M.D.⁽¹⁾

Waritta Kunprom, M.D.⁽³⁾

From ⁽¹⁾Department of Radiology, ⁽²⁾Department of Surgery, ⁽³⁾Department of Pathology, Faculty of Medicine, Khon Kaen University, Khon Kaen, 40002, Thailand.

Address correspondence to M.W. (email: mixwan@kku.ac.th)

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Abstract

Bulky, mass-like leptomeningeal metastasis is rare. In radiology and surgery, it mimics an extra-axial mass and can be mistaken for meningioma. When reported pathologically as metastasis, it can be mistaken for parenchymal brain tumors, potentially delaying appropriate CSF-directed therapy. We report a unique case in which leptomeningeal disease presented as an extra-axial lesion embedded in the cortex with a comedo-like protruding surface. Recognizing this imaging and intraoperative appearance may be important, as differentiating leptomeningeal from parenchymal metastases could alter prognosis and help guide treatment decisions, including consideration of CSF-directed treatments, such as intrathecal chemotherapy or craniospinal irradiation, rather than relying on focal radiosurgery alone. Although anecdotal, this report underscores the need for heightened diagnostic awareness and warrants the need for further study to determine whether this feature reliably indicates leptomeningeal disease and meaningfully influences patient management.

Keywords: Comedo-like morphology, Differential diagnosis, Extra-axial mass, Leptomeningeal metastasis, Mimics.

Introduction

When evaluating an intracranial mass on MRI, the first step is to distinguish intra-axial from extra-axial location. Definitive findings of an extra-axial lesion are a cerebrospinal fluid cleft separating the lesion from the brain, interposed cortical vessels, preservation of the cortex between the mass and white matter edema and an intact dura between a potential epidural mass and the parenchyma. Suggestive findings include a broad-based peripheral attachment along the calvarium, focal bone remodeling or sclerosis of the adjacent skull, enhancement of the overlying meninges and displacement of brain away from the inner table without true infiltration [1]. Once an extra-axial location is established, the differential diagnosis narrows to dural-based entities such as meningioma or solitary fibrous tumor, and, in rare cases, to dural metastasis even in patients without a known primary malignancy.

Leptomeningeal metastasis classically appears as diffuse linear or nodular leptomeningeal enhancement along the sulci, cranial nerves and cisterns. While "linear" and "nodular leptomeningeal enhancement" are well-established descriptors, there is no widely used term for a discrete, bulky leptomeningeal mass [2]. However, in this case we observed a comedo-like appearance, in which the lesion demonstrated definitive extra-axial radiologic features, yet was largely embedded within the brain parenchyma with only a small portion of the tumor surface protruding into the subarachnoid space. This pattern may represent a focal, bulky leptomeningeal deposit.

Case summary

A 49-year-old male presented with right hemiparesis for two days. His past medical history was unremarkable, with no known primary malignancy at presentation. Neurologic examination revealed grade II right hemiparesis.

MRI Findings: The patient underwent contrast-enhanced brain MRI for evaluation of these neurological symptoms. MRI revealed a well-circumscribed, heterogeneously enhancing mass along the left parieto-occipital convexity. It appeared iso- to slightly hypointense on T1WI and isointense on T2WI and FLAIR with iso-diffusion. A thin CSF rim (CSF cleft sign) and preserved cortical interface suggested an extra-axial location. Moderate surrounding white matter edema was observed. No significant bone involvement was seen. The initial impression favored meningioma (including atypical meningioma) or hemangiopericytoma, with metastasis considered unlikely due to extra-axial location, solitary presentation, and absence of known systemic malignancy. (Figure 1 and 2)

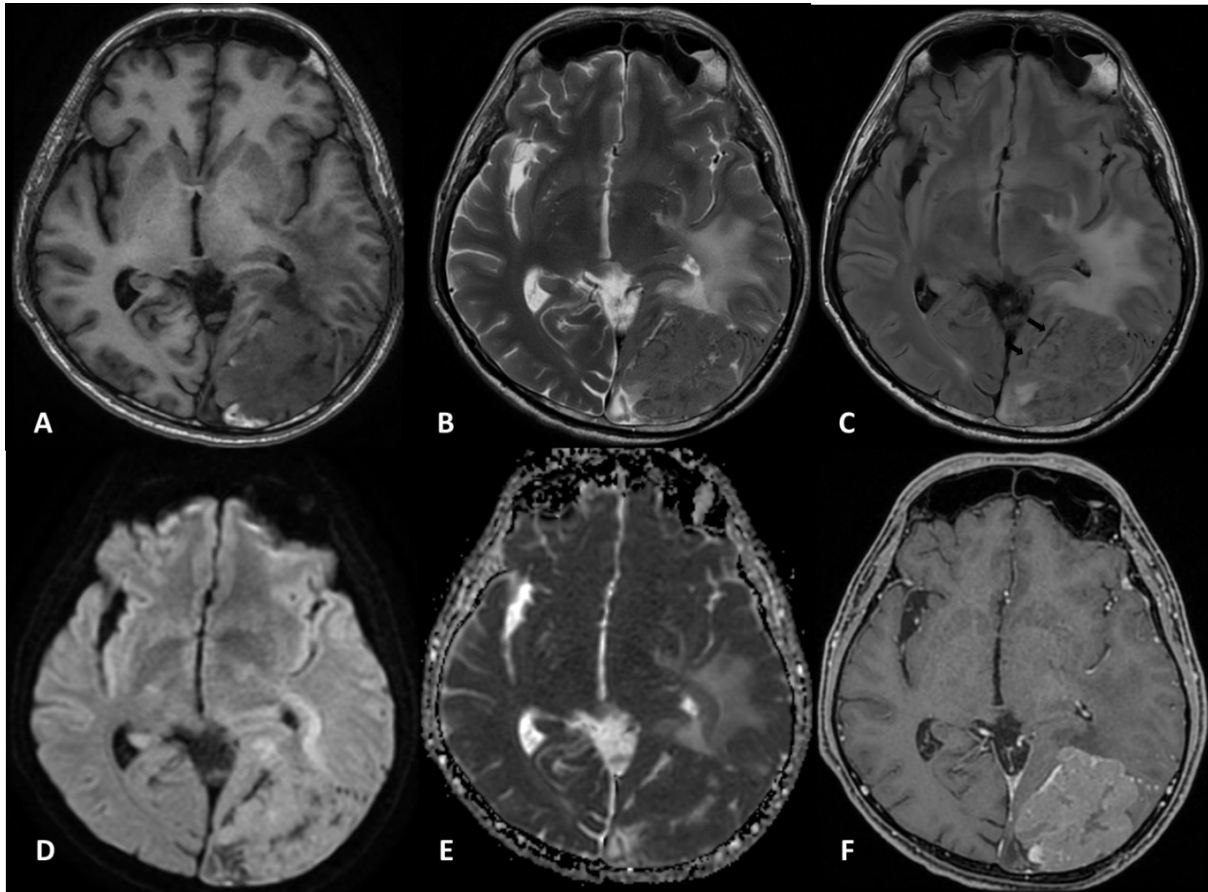


Figure 1. MRI shows a well-defined heterogeneous enhancing mass over the left parieto-occipital convexity with associated perilesional white matter edema. (A) Axial T1WI, (B) T2WI, (C) FLAIR, (D) DWI, (E) ADC and (F) post-contrast T1WI show a heterogeneous lesion with mixed hypo- to isointense signal on T1WI and heterogeneous isointense signal on T2WI and FLAIR. The lesion demonstrates isodiffusion on DWI and ADC. Mild, heterogeneous solid enhancement is seen post-contrast T1WI.

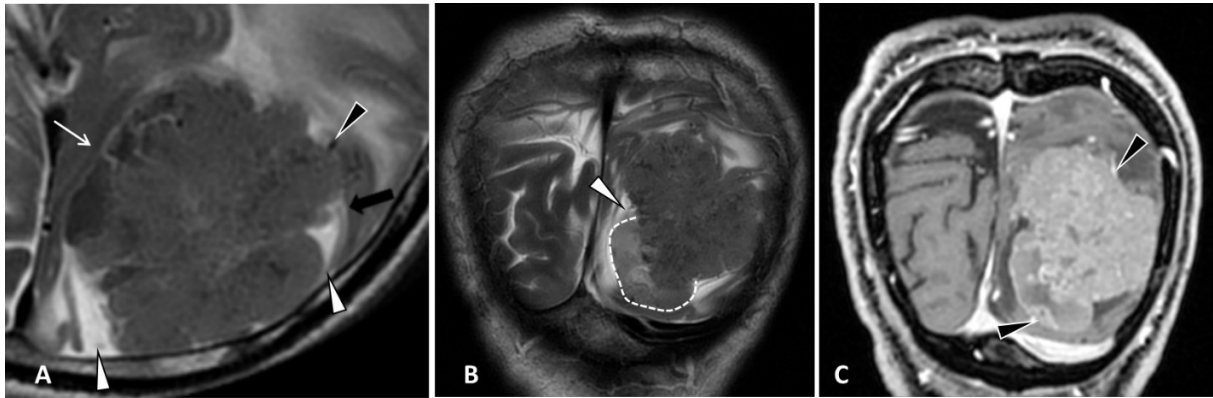


Figure 2. MRI shows a close-up view of the mass. (A) Axial T2WI, (B) Coronal T2WI, (C) Coronal T1WI+Gd show the CSF-cleft sign (white arrowhead in A and B), intervening vessels (black arrowhead in A and C), an intervening cortex between mass and white matter (black arrow in A) and white matter buckling sign (white arrow in A). The dashed line in (B) represents the portion of the tumor surface protruding outward.

Intraoperative Findings: The tumor appeared firm, well-defined, and embedded within the brain parenchyma. A small part of the mass was visible at the surface. It was easily dissected with a preserved plane from the brain, except for minor focal adherence to the brain parenchyma. No true dural attachment was identified. The characteristic “comedo-like” term, as used here, refers to the lesion’s imaging and intraoperative morphology: a sharply demarcated mass embedded in the brain surface, partially protruding from the cortical surface, with minimal cortical brain invasion, resembling a comedo or blackhead embedded beneath the skin with a visible surface component (Figure 3).

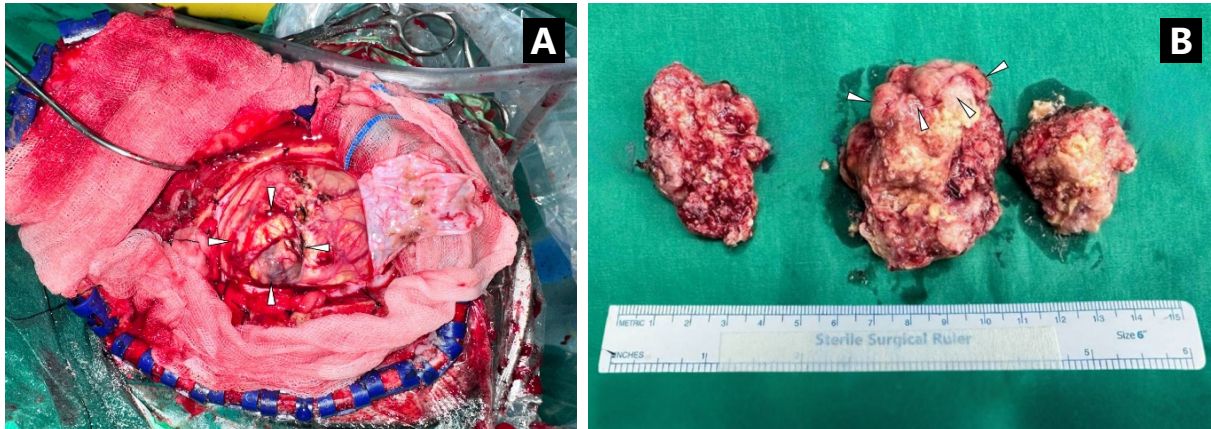


Figure 3. Intraoperative photo (A) and gross specimens (B) show a lobulated-surface mass subtly emerging from the brain surface (arrowhead), with the majority of the mass embedded within the brain, consistent with the “comedo-like” description.

Pathologic Findings: Histological examination demonstrated a well-circumscribed lesion with a pushing border, composed of atypical glandular, papillary, and micropapillary architectural patterns. Scattered foci of necrosis were also observed. Tumor cells were identified within the leptomeninges and lymphovascular spaces, with only minimal involvement of the adjacent brain parenchyma. Immunohistochemical staining was positive for TTF-1 and Napsin A, consistent with metastatic pulmonary adenocarcinoma. (Figure 4 and 5)

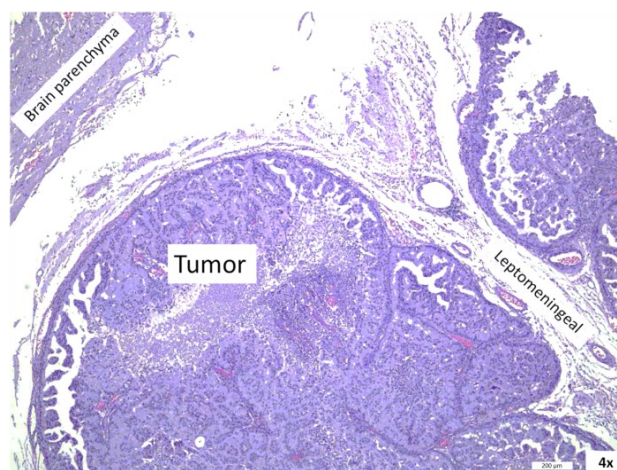


Figure 4. Histologic section (magnification = 4X and scale bar = 200 μm) demonstrates a well-circumscribed tumor centered within the leptomeningeal space, composed of atypical glandular, papillary, and micropapillary structures with focal necrosis. These features are consistent with leptomeningeal metastatic adenocarcinoma.

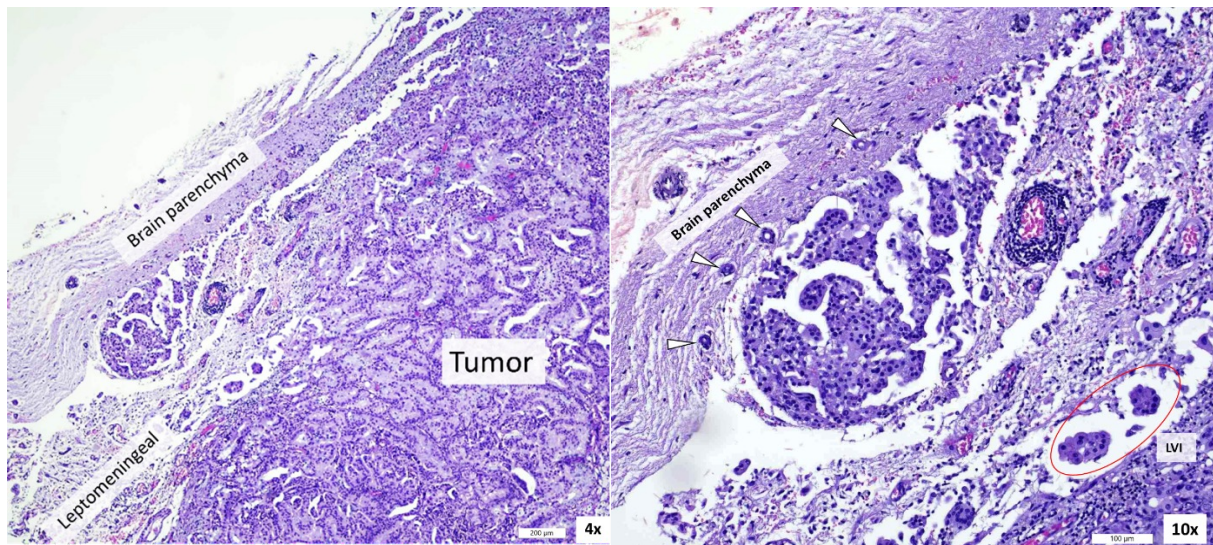


Figure 5. Histologic sections at (A) 4× magnification (200 μm scale bar) and (B) 10× magnification (100 μm scale bar) demonstrate tumor involvement of the leptomeninges, with infiltration into lymphovascular channels (LVI) and focal extension into the adjacent brain parenchyma (arrowhead). These findings support a leptomeningeal origin with secondary parenchymal invasion.

Discussion

In radiologic practice, classifying an intracranial mass as extra-axial typically directs attention toward dural-based pathology, particularly meningiomas and solitary fibrous tumors [3,4]. However, this focus can be overly restrictive and may lead to under-recognition of lesions arising from the pia and arachnoid mater, which together form the leptomeninges. This limitation is particularly relevant when leptomeningeal metastases present as focal, mass-like lesions, rather than in the more common diffuse pattern [2,5,6].

In the present case, the mass was correctly localized radiologically and surgically as extra-axial but was initially presumed to be dural-based, and the histopathologic diagnosis of metastasis was initially interpreted clinically as parenchymal “brain” metastasis. Only after pathologic re-evaluation, prompted by the imaging appearance and intra-operative impression, was the lesion recognized as leptomeningeal metastasis. This case underscores that the term “extra-axial” encompasses not only dural lesions but also leptomeningeal pathology and highlights the importance of distinguishing these compartments when evaluating superficially embedded, well-marginated intracranial masses.

Recognizing leptomeningeal spread rather than parenchymal disease has direct implications for management and prognosis [7]. A solitary bulky parenchymal metastasis is often managed with surgical resection followed by stereotactic radiosurgery or focal radiotherapy[8]. In contrast leptomeningeal disease calls for cerebrospinal fluid-directed therapies such as intrathecal chemotherapy or high-dose systemic chemotherapy and often craniospinal irradiation. Even when a focal mass is amenable to radiosurgery it must be combined with CSF-directed treatment given the risk of diffuse multifocal recurrence [7].

We propose the term “comedo-like” to describe the lesion’s distinctive imaging and surgical morphology, which we believe may represent a reproducible and recognizable pattern that raises suspicion for leptomeningeal origin. On MRI, the mass appeared as a smoothly marginated, contrast-enhancing lesion subtly protruding beyond the cortical margin, suggesting a subarachnoid or leptomeningeal source. This configuration resembles a comedo, in which a subepidermal lesion becomes externally visible through a small surface breach, in this case, the cerebral cortex. Although observed in a single case, this pattern may offer a useful visual clue when considering atypical pathology in superficially embedded lesions, thereby guiding more accurate diagnosis and oncologic management. Further studies are warranted to determine whether this imaging feature can help differentiate leptomeningeal metastases from more common benign extra-axial tumors.

In conclusion, we report a rare case of leptomeningeal metastasis presenting as a circumscribed, extra-axial mass with a “comedo-like” configuration on preoperative MRI and intraoperative assessment. This distinctive presentation challenges conventional diagnostic assumptions and emphasizes the need for radiologists and pathologists to consider leptomeningeal metastasis in the differential diagnosis of superficially embedded, well-marginated intracranial masses. While anecdotal, the “comedo-like” appearance may serve as a helpful radiologic feature worthy of further study. Increased awareness of this imaging pattern may facilitate earlier diagnosis and appropriate oncologic intervention.

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

This study is approved by the Ethics Committee for Human Research, Khon Kaen University.

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