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CASE REPORT

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Osteoblastoma of the frontal sinus: A rare case presenting with seizures and pneumocephalus

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Key Clinical Message

Osteoblastoma of the frontal sinus, although rare, can manifest with seizures and pneumocephalus, underscoring the importance of thorough evaluation and complete surgical excision to prevent serious complications and ensure optimal patient outcomes.

Abstract

Osteoblastoma is an infrequent bone tumor, with origins typically in the vertebrae and long bones. While craniofacial involvement is rare, it may occur in regions such as the paranasal sinuses. We present a case of osteoblastoma located in the frontal sinus, an exceptionally uncommon site, resulting in seizures secondary to pneumocephalus. A 21-year-old male presented with a generalized tonic–clonic seizure and postictal confusion. Imaging studies revealed a well-defined lesion in the left frontal sinus causing cortical breach, destruction of the posterior wall, and pneumocephalus. A total surgical excision was performed through bifrontal craniotomy. Histopathological analysis confirmed the diagnosis of osteoblastoma. Postoperative recovery was uneventful, with a follow-up CT scan showing complete lesion excision. Osteoblastomas, especially in the cranial sinuses, are rare entities that may present asymptomatically but can lead to severe complications. The risk of recurrence underscores the importance of complete surgical resection for optimal patient outcomes.

KEYWORDS

cranial tumors, frontal sinus, osteoblastoma, pneumocephalus, seizures, surgical excision

1 | INTRODUCTION

Osteoblastoma is a rare bone tumor, typically originating from the vertebrae and long bones.[1] Accounting for less than 1% of excised primary osseous tumors and approximately 3% of benign osseous tumors, it is an uncommon osseous lesion.[1] While craniofacial involvement is exceptionally infrequent, it may manifest in regions such as the paranasal sinuses and orbits.[2] Sidani et al.[3] reported the first case of craniofacial osteoblastoma arising in the frontal sinuses. Subsequently, Caltabiano et al.[4] described the fifth case reported in the English scientific literature. To date,

fewer than 10 cases have been reported. Characterized by hypocellular mineralized tissue forming large masses or irregular trabeculae, this tumor comprises numerous hyperchromatic osteoblasts and occasional osteoclast-like giant cells embedded in a vascular fibrous stroma. In this report, we present a case of osteoblastoma located in the frontal sinus, leading to seizures secondary to pneumocephalus.

2 | CASE HISTORY/EXAMINATION/PRESENTATION

A 21-year-old gentleman presented with a single episode of generalized tonic–clonic seizure at home, followed by postictal confusion. Additional symptoms included mild disorientation, restlessness, and bifrontal headache. No history of trauma, fever, or nasal discharge was reported. Neurological examination revealed no deficits, and the patient had no known comorbidities. During the transfer for an MRI, the patient experienced a second seizure. Imaging studies, including MRI and complementary CT, identified a well-defined, bone density lesion in the left frontal sinus with dimensions of $1.7 \times 1.8 \times 2.5$ cm. The lesion was isointense on T2 and FLAIR, hypointense on T1, with no diffusion restriction. A posterior component of the lesion breached the cortical wall, eroding the posterior wall of the left frontal sinus, leading to intracranial extension and pneumocephalus formation (Figures 1 and 2).

3 | METHODS (DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT)

Differential diagnoses were considered based on the imaging findings and clinical presentation. The decision for a

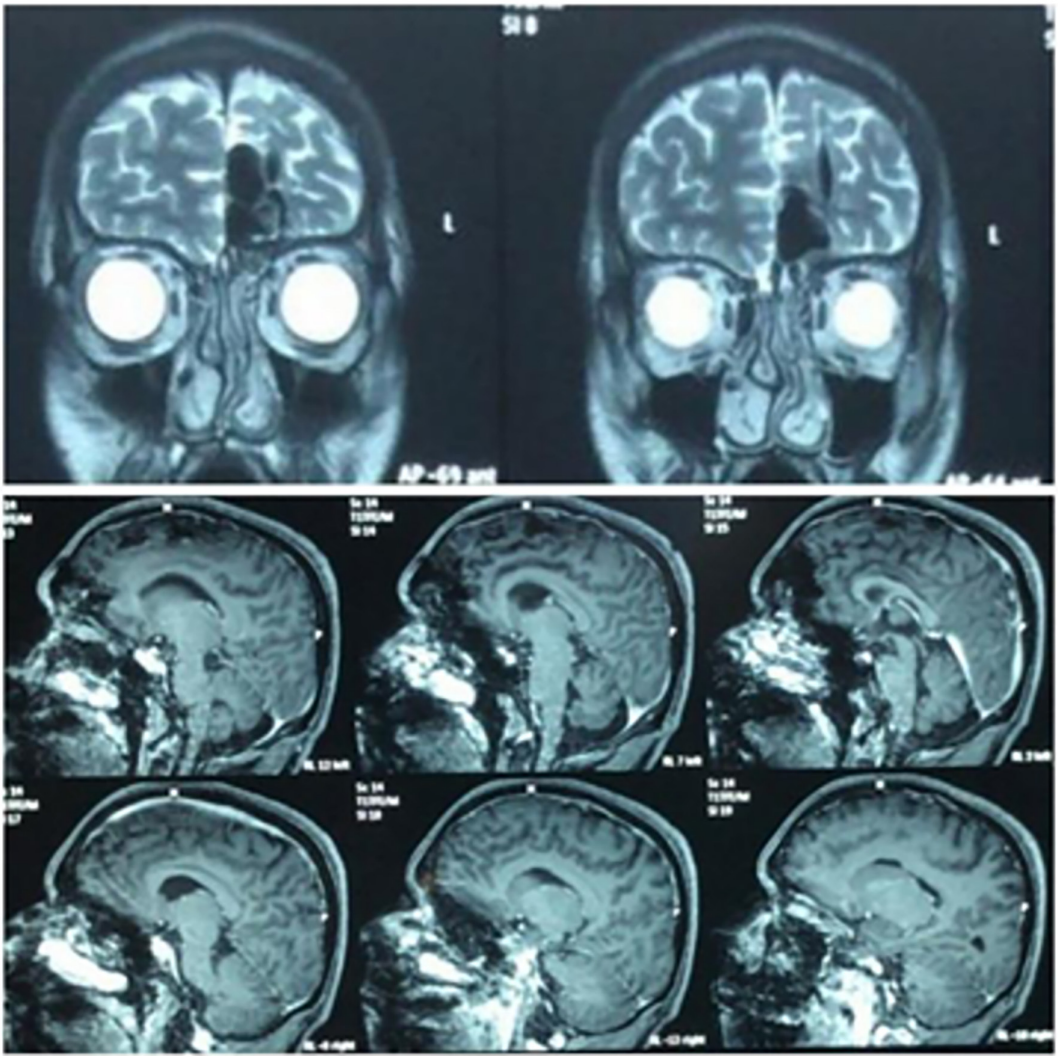

FIGURE 1 Preoperative brain MRI demonstrating the lesion in the left frontal sinus, revealing isointensity on T2 and FLAIR, hypointensity on T1, with evidence of cortical breach and intracranial extension.

bifrontal craniotomy was made, involving total excision of the lesion, dural repair, and frontal sinus packing under general anesthesia. Intraoperatively, a bony lesion arising from the posterior wall of the frontal sinus, causing dural breach and impinging on the brain parenchyma, was observed. Histopathological analysis revealed an arrangement of interconnected trabeculae composed of osteoid tissue, surrounded by robust osteoblasts within a stroma of cellular connective tissue. Multinucleated giant cells were also noted within the lesion. The clear demarcation between the lesion and normal bone confirmed the diagnosis of osteoblastoma (Figure 3).

4 | RESULTS (OUTCOME AND FOLLOW-UP)

The patient's postoperative recovery was uneventful, and he was discharged on the third postoperative day. A follow-up head CT scan at 2 weeks showed total excision of the lesion, confirming the success of the surgical intervention (Figure 4). A follow-up head CT scan was scheduled for 6 months, but the patient underwent the examination at another center, so there is no data on the potential recurrence.

5 | DISCUSSION

Osteoblastomas, which constitute approximately 1% of all primary bone tumors, were first described by Jaffe and Mayer in 1932.[5] They identified these tumors as originating from osteoblastic osteoid tissue formation and observed their occurrence in the fourth metacarpal bone of a 15-year-old female.[6] While these tumors commonly occur in the long bones, vertebral column, and small bones of the hands and feet, their occurrence in the skull and jaw bones is relatively rare, representing only 15% of all osteoblastomas.[7,8] The tumor exhibits a male predilection and comprises less than 1% of all tumors in the maxillofacial region.[9] Primary osteoblastoma of the frontal sinus, as observed in our patient, is particularly uncommon, involving the left frontal sinus and leading to erosion of the posterior wall and invasion of the brain parenchyma.

Osteoblastomas are often asymptomatic in their early stages, but due to their anatomical location within the

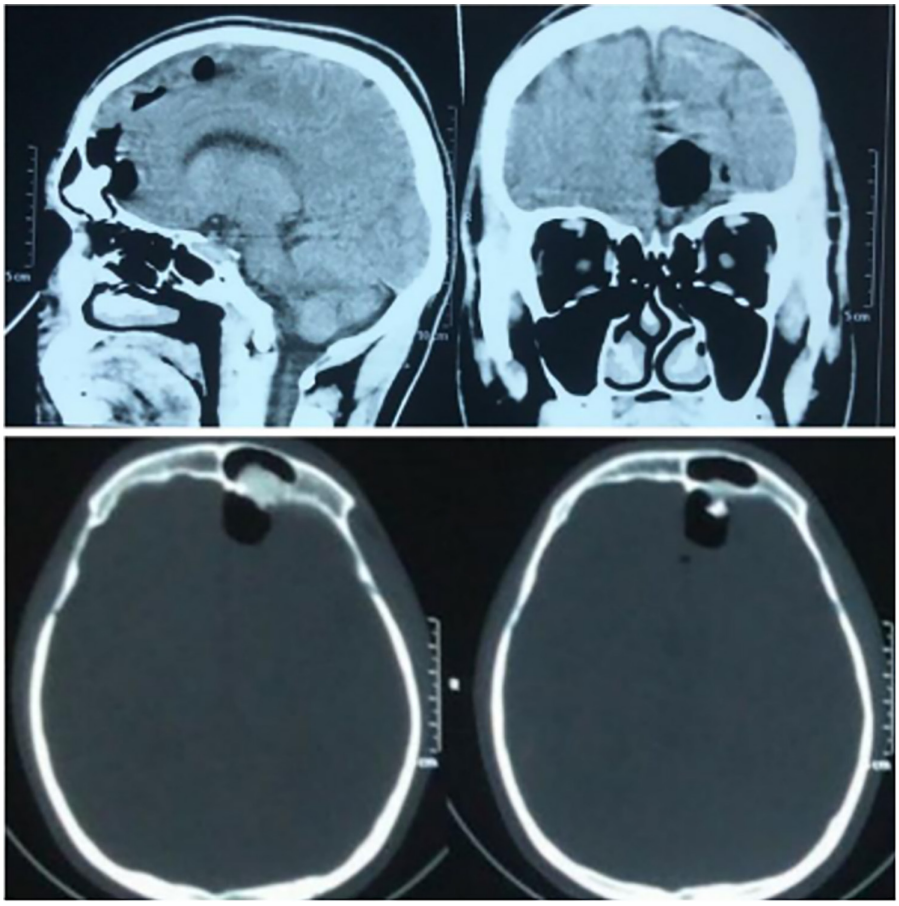

FIGURE 2 Preoperative head CT scan showing a well-defined lesion in the left frontal sinus with cortical breach, destruction of the posterior wall, and pneumocephalus.

frontal sinus, patients may experience severe orbital and intracranial complications, including proptosis, diplopia, amaurosis fugax, Cerebrospinal fluid fistula, meningitis, and pneumocephalus.[10,11] While uncomplicated osteomas typically present with facial pain and headaches, pneumocephalus may unexpectedly manifest as the initial sign of a previously unrecognized osteoma.[12] In our case, the patient presented with a seizure without prior symptomatic indications. On imaging, osteoblastomas appear expansile and tend to remodel adjacent bone. Lesions in the nasal cavity and paranasal sinuses are usually well-circumscribed without causing significant bone destruction, in contrast to lesions elsewhere in the skeleton.[13] The mixed components of the lesion, with a dense sclerotic portion and a fibrous portion, pose a differential diagnosis challenge, particularly with fibrous dysplasia. While CT may present challenges in differentiation, the nodular and coarsely organized appearance of an osteoblastoma tends to be more distinct than that of most fibrous dysplasias. MRI is valuable in assessing the involvement of adjacent vital structures during pre-operative evaluation, revealing signal characteristics of the sclerotic and fibrous components. Histologically, osteoblastoma closely resembles an osteoid osteoma but is differentiated based on size, with lesions larger than 1.5 cm classified as osteoblastomas.[14,15] The tumor exhibits islands of osteoid tissue undergoing varying degrees of calcification and significant osteoblastic activity within a well-vascularized fibrous connective tissue stroma. Plump osteoblasts form trabeculae of osteoid and bone, set in a markedly well-vascularized fibrous stroma with collagen fibers. A complete surgical excision is the preferred treatment for symptomatic osteoblastomas due to the risk of pathological fractures and

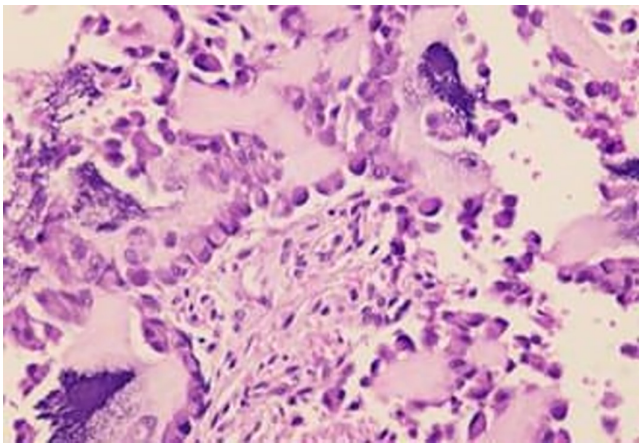

FIGURE 3 Histopathological analysis revealing interconnected trabeculae composed of osteoid tissue, surrounded by robust osteoblasts within a stroma of cellular connective tissue, confirming the diagnosis of osteoblastoma.

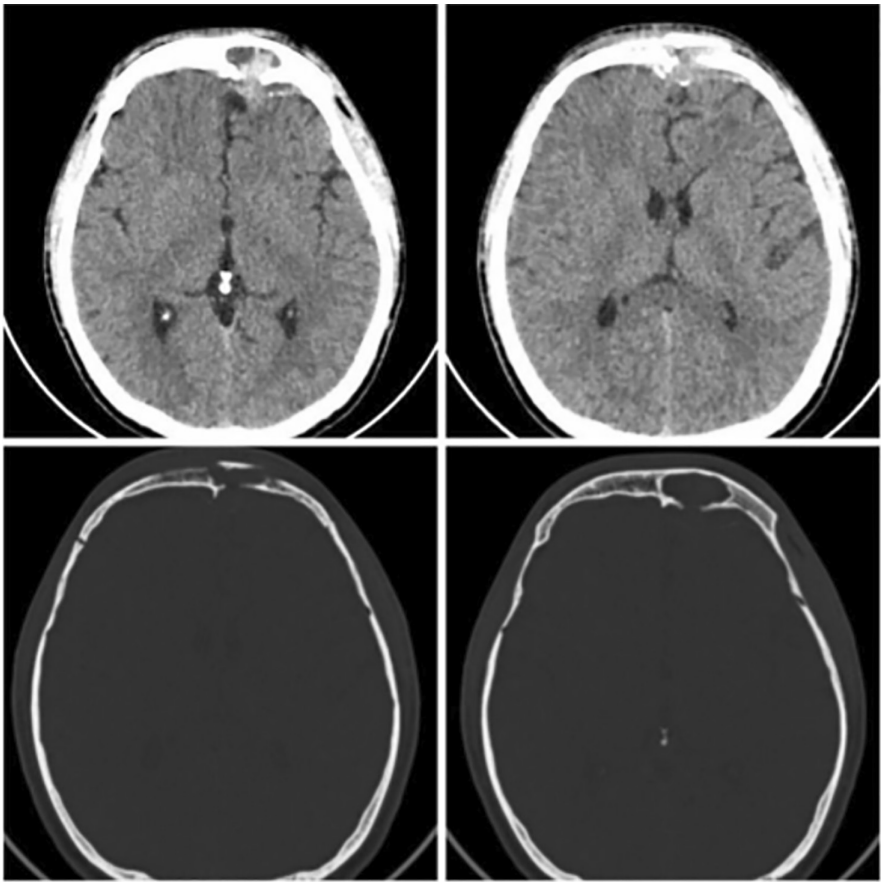

FIGURE 4 Postoperative head CT scan showing successful total excision of the lesion in the left frontal sinus, confirming the success of the surgical intervention.

potential functional impairments. Malignant transformation into osteosarcoma, though extremely rare, has been reported.[16] Radiation or chemotherapy have limited roles in treatment, potentially considered in selected cases with recurrent or unresectable osteoblastomas.[17] Local recurrence after incomplete resection is not uncommon, emphasizing the importance of complete resection.[8,18,19] In our case, total tumor resection was achieved with primary dural repair and meticulous packing, along with exteriorization of the sinus using pericranium.

6 | CONCLUSION

Osteoblastomas originating from cranial sinuses represent rare entities, often presenting asymptomatically but carrying the potential for serious complications with intra-orbital or intra-cranial extension. Given the risk of recurrence, complete surgical resection stands as the preferred management strategy, emphasizing the importance of thorough removal to mitigate potential complications and ensure optimal patient outcomes. Continued research and clinical vigilance are essential to better understanding the behavior and management of these uncommon tumors.

AUTHOR CONTRIBUTIONS

Dattatraya Mallik: Conceptualization; resources; software. **Nandyal Chandrashekhar:** Conceptualization; resources; software. **Abhishek Kumar Rai:** Conceptualization; resources; software. **Saransh Dhingra:** Data curation; formal analysis; resources; software. **Gaurav Arora:** Data curation; formal analysis; software. **Sapan Gandhi:** Data curation; resources; software. **Gianluca Scalia:** Supervision; validation; visualization; writing – review and editing. **Bipin Chaurasia:** Supervision; validation; visualization; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable—no new data generated, or the article describes entirely theoretical research.

ETHICS STATEMENT

This case report was compiled after obtaining informed consent from the patient for the disclosure of clinical history and management with the intention of publication. All attached imaging and clinical materials were de-identified to ensure patient anonymity.

CONSENT

Informed consent was taken from the patient, including permission of printing his images.

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