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Case Report

Surgical management of giant cell tumor invading the occipital bone: A case report and literature review

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ABSTRACT

Background: Giant cell tumor of bone (GCTB) rarely originates in the skull, particularly in the occipital bone. Although benign, it can severely destroy the surrounding tissue and undergo an unpredictable clinical course. We report the successful resection of a GCTB invading the occipital bone in a Hispanic adult woman and present a comprehensive review of the literature on this rare pathology by focusing on the occipital area.

Case Description: A 40-year-old Hispanic woman presented with a 3-month history of neck pain and a bulging lesion on the retromastoid area. Brain magnetic resonance imaging (MRI) revealed an extradural, expansive, and contrast-enhancing lesion in the right occipital bone with multiple thin septa and evidence of bleeding. The patient underwent an uneventful gross total resection (GTR) of the lesion. The histopathological examination findings included numerous scattered osteoclast-type giant multinucleated cells. At a 10-month follow-up, the patient has not developed any neurological deficits, impairment of life functioning, or signs of recurrence in MRI.

Conclusion: GCTB rarely originates in the skull, being the occipital bone the most infrequent site of presentation. When feasible, total surgical resection effectively reduces the risk of recurrence. Nonetheless, radiation and adjuvant therapies have been employed when GTR could not be achieved. A close follow-up with a brain MRI is advised to control recurrence.

Keywords: Case report, Giant cell tumor of bone, Occipital bone, Skull tumor, Surgical management

INTRODUCTION

Giant cell tumor of bone (GCTB), also known as "osteoclastoma," represents 3–5% of primary bone tumors and 10–20% of those of benign origin.[2,27] It commonly originates from the epiphysis of long bones, where it destroys the bony tissue. The skull is a rare presentation site and accounts for <1% of cases.[2,12] Particularly, few cases have been reported in the occipital bone compared to the temporal, frontal, sphenoid, and ethmoidal bones.[4-7,13,15-17,19,21-23,26,28-31,33,37,43,45,47-49,51,53-55] Weng *et al.* reported that the overall distribution of cases in the occipital bone was 9.8%.[51] This tumor is more common among adults, and gender distribution has been previously reported to be more common in females.[27] However, a systematic review revealed that it might be equal among adults.[12]

The risk factors for the origin of GCTB in the skull base or vault are still unknown.[2,27,46,51] From an embryological point of view, GCTB was thought to originate from bones in the skull base

formed by endochondral ossification, such as the sphenoid and temporal bones.[5,20,53] Nevertheless, cases in cranial vault bones that form by intramembranous ossification have challenged the initial paradigm.[24,25] As exemplified in our case, the tumor originated in the occipital bone.

Despite the benign nature of this tumor, its clinical behavior may be unpredictable, and the treatment is highly dependent on location, especially in the skull.[51] Furthermore, the recurrence rate can reach up to 30%.[12,15,51] The causes of recurrence after surgical resection are unclear, and the clinical outcomes differ with treatment modalities used in GCTB of long bones.[12]

We conducted a review of the literature, which yielded 27 reported cases of GCTB originating in the occipital bone (retrieval of full-text information, including patient sex and age, type of treatment, and presence of recurrence during the follow-up was possible in 22 cases, and is shown in Table 1).[1,4,7,13,15-17,21-23,26,28-31,33,43,45,47-49,51,54,55] To the best of our knowledge, this is the first case of a GCTB of the occipital bone in a Hispanic patient. Besides, our review constitutes the most comprehensive compilation of cases in the occipital region.

CASE REPORT

A 40-year-old Hispanic woman presented to the clinic with a 3-month history of neck pain and a bulging lesion on the retromastoid area. The patient had no significant medical history. The physical examination showed a tender and swollen area on the right lateral side of the occipital bone, behind the mastoid process. Besides, the neurologic examination was intact without motor, visual, or sensory deficits.

A brain magnetic resonance imaging (MRI) was obtained. The T1-weighted image with gadolinium showed an extradural and contrast-enhancing lesion destroying the inner and outer layers of the right occipital bone, which extended into the scalp and posterior fossa. It measured 42.5 × 33.5 × 39 mm. The T2-weighted image and the fluid-attenuated inversion recovery (FLAIR) sequence demonstrated a hypointense lesion with multiple thin septa, fluid-fluid levels, and signs of a hemorrhagic component [Figure 1].

Surgical management

The patient was placed in a three-quarter prone position with flexion of the neck and slight head rotation. Then, a

Table 1: Case reports of giant cell tumor of the occipital bone.

S. No.	Author (year)	Age*	Sex	Treatment	Follow-up period and presence of recurrence	
1.	Troell *et al*. (1930)[48]	20	M	STR	3 years	No
2.	Moyes (1970)[31]	13	F	STR+2650 rads in 12 days	9 months	No
3.	Arseni (1975)[1]	8	F	GTR	7 years	No
4.	Motomochi *et al*. (1985)[30]	53	M	Partial resection+2400 rads	2 years	No
5.	Henderson and Whitwell (1988)[17]	16	F	GTR	1.3 years	No
6.	Sharma and Newton (1991)[43]	12	M	GTR	2 weeks	No
7.	Bertoni *et al*. (1992)[4]	58	F	STR+RT	12 months: death	Yes
		28	F	STR+RT	7 years	No
		61	F	STR+RT	10 years	No
8.	Opitz *et al*. (1996)[33]	24	M	STR	NR	Yes
9.	Harris *et al*. (2004)[16]	24	F	GTR	NR	
10.	Young-Min *et al*. (2004)[54]	25	F	GTR	NR	
11.	Modkovski *et al*. (2009)[29]	27	F	GTR	16 months	No
12.	Sung *et al*. (2010)[45]	7	M	GTR	NR	
13.	Lu *et al*. (2011)[28]	19	F	GTR	1 year	No
14.	Zhang *et al*. (2013)[55]	19	F	GTR	31 months	No
15.	Uslu *et al*. (2014)[49]	22	F	STR+50 Gy by external RT+200 cGy/fraction	20 months	No
16.	Kalani *et al*. (2017)[23]	73	F	GTR	5 months	No
17.	Töret *et al*. (2019)[47]	10 days	M	Cisplatin 1 mg/kg/day (1–3 days) and doxorubicin 1 mg/kg/day (1,2 days) 4 times monthly	60 months	No
18.	Kajiwara *et al*. (2019)[22]	56	M	STR+Denosumab	5 years	No
19.	Kadipasaoglu *et al*. (2021)[21]	9	F	GTR	0.5 years	No
20.	Chugh *et al*. (2022)[7]	13	M	GTR	6 months	No
21.	Present Case (2022)	40	F	GTR	10 months	No

F: Female, GTR: Gross total resection, M: Male, NR: Not reported, RT: Radiotherapy, STR: Subtotal resection, *Reported in years except in one patient.

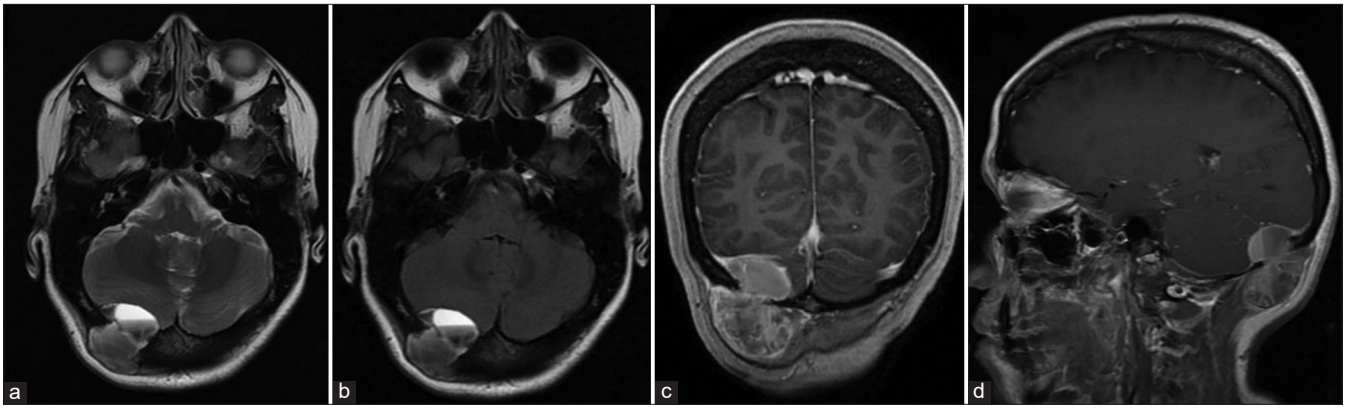

Figure 1: Patient MRI findings. (a) T2WI axial view. (b) FLAIR axial view. (c) T1 + Gd coronal view. (d) T1+Gd sagittal view.

suboccipital craniotomy was performed with complete gross total resection (GTR) of the lesion. On lifting the scalp, an irregular, rounded, and brownish lesion was exposed at the surface of the right occipital bone [Figures 2 and 3a]. Besides, a deep part of the tumor invading the posterior fossa was resected [Figure 3b]. Surgery was completed without intraoperative complications. Postoperatively, the patient neurologic examination was normal. An MRI was obtained and showed complete resection of the tumor [Figure 4].

Histopathological findings

The histopathological examination of the tumor revealed fusocellular proliferation with fibrohistiocytic characteristics and hemorrhagic changes, zones of hemosiderin, and significant proliferation of scattered osteoclast-type giant multinucleated cells [Figure 5]. These findings suggested the diagnosis of a giant cell tumor of the occipital bone.

Follow-up

The patient has been followed up for 10 months, and she has not developed any neurological deficits or impairment of life functioning. In addition, a brain MRI has shown absent signs of recurrence or tumor proliferation in the occipital bone and surrounding tissue [Figure 6].

DISCUSSION

GCTB is a rare entity in the skull, particularly in the occipital area.[6,11,12,51] It commonly affects adults, but cases in children and even newborns have also been reported.[9,41,47] According to a systematic review of cases originating in the skull, the gender distribution seems equal.[12] However, some series have reported slight female or male predominance.[21,24,51] In our review of reported cases in the occipital region, most patients were female adults; interestingly, the youngest patient was a 10-day male newborn [Table 1]. GCTB has also been reported in patients with neurofibromatosis,

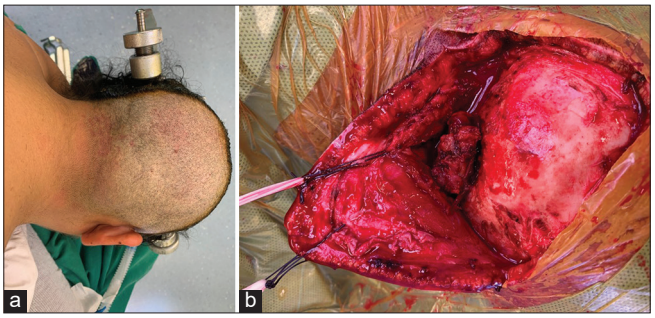

Figure 2: Intraoperative findings. (a) The patient was placed in a three-quarter position; after hair clipping, an edematous area was exposed in the retromastoid area. (b) After scalp lifting, an irregular, rounded, and brownish lesion in the right occipital bone was uncovered.

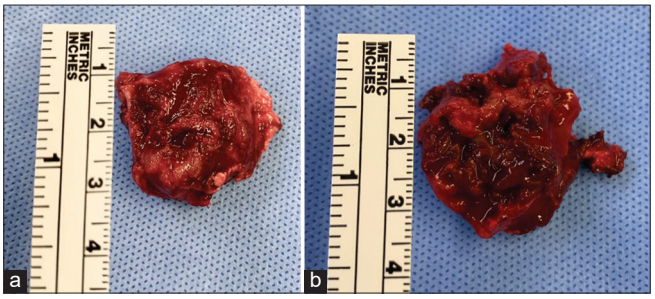

Figure 3: Gross examination of the tumor. (a) The superficial component of the tumor was an irregular brownish round lesion of 2.5 × 2 × 0.3 cm. (b) The deep component of the tumor measured 4 × 3.5 × 1.5 cm.

aneurysmal bone cysts, and Paget's disease; however, there is no clear association, and risk factors remain unknown.[19,29,33]

GCTB is considered a benign pathology, yet it can be aggressive when invades the surrounding tissue. Although infrequent, it may also present as a malignant variant.[35] Besides, metastases can occur to the lungs, which usually course asymptomatic and associated with good treatment response.[34,35]

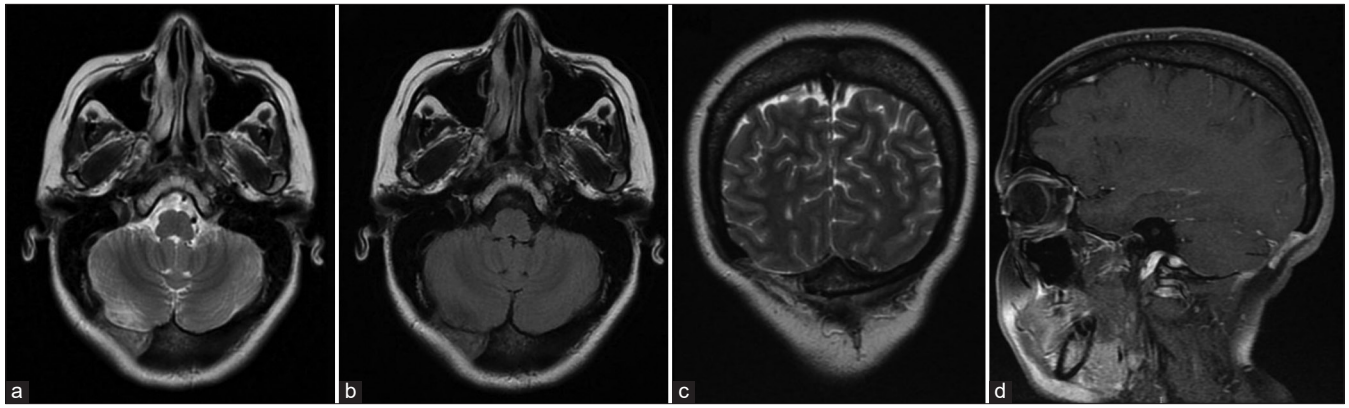

Figure 4: Postoperative MRI. (a) T2WI axial view. (b) FLAIR axial view. (c) T2WI coronal view. (d) T1 +Gd sagittal view.

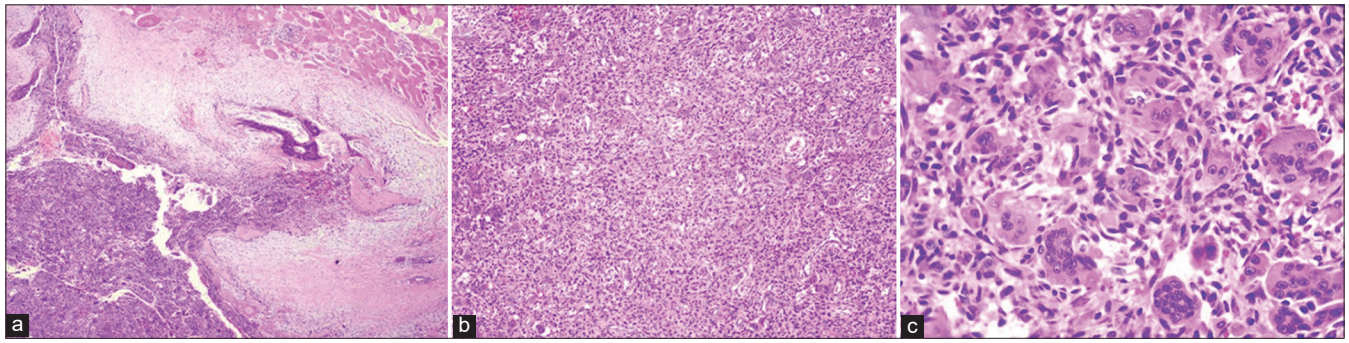

Figure 5: Histopathological examination of the tumor with hematoxylin and eosin (H&E) stain. (a) ×100. (b) ×400. (c) ×1000 magnification showing niches of giant multinucleated osteoclast-like cells.

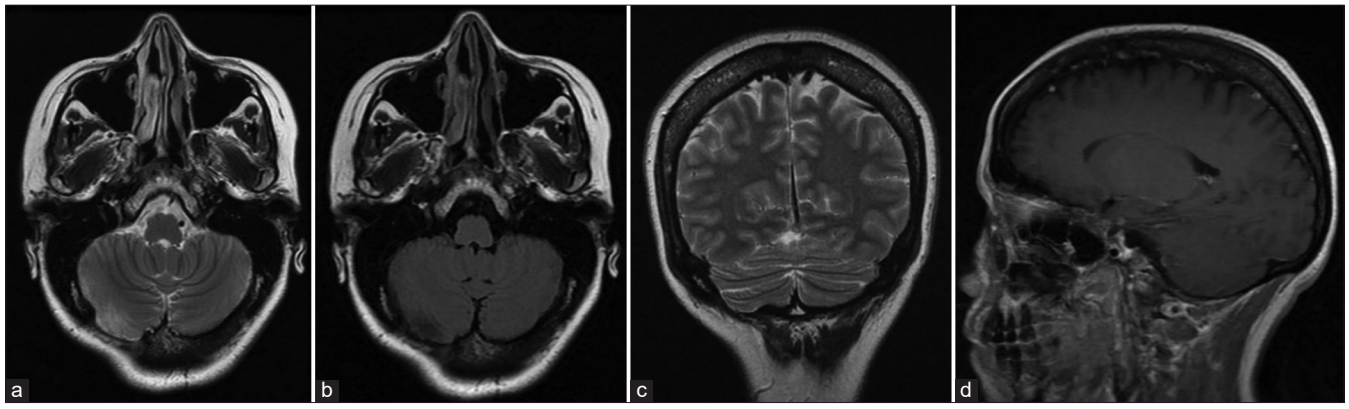

Figure 6: Brain MRI at 8-month follow-up. (a) T2WI axial view. (b) FLAIR axial view. (c) T2 coronal view. (d) T1 FLAIR sagittal view.

The clinical presentation of GCTB in the occipital area is usually described as a tender and swollen lesion accompanied by headache, neck pain, vomiting or swelling of the affected area, and, less commonly, seizures.[55,23] Furthermore, depending on the tumor extension into the neighboring area, it might cause lower cranial nerve deficits.[51]

Differential diagnosis

The differential diagnosis of GCTB includes giant cell reparative granuloma, Paget's disease of the bone, aneurysmal cyst bone, chondroblastoma, chondromyxoid fibroma, nonossifying fibroma, fibrous dysplasia, pigmented villonodular synovitis, foreign body reactions, and brown tumors from hyperparathyroidism.[8,39,42,50] These pathologies might be differentiated based on clinical history, laboratory tests, and imaging characteristics; nevertheless, a histopathological diagnosis is required. Although not pathognomonic, the common finding in a bone biopsy includes multiple multinucleated giant cells accompanied by ovoid-/spindle-shaped stromal cells.[2] In addition, GTCB can be characterized

through molecular and immunohistochemical markers, but their utility for screening and diagnosis has not been extensively proved.[12,51] The tumor may exhibit high expression of the receptor activator of nuclear factor-kappa B ligand (RANKL), antigen Ki-67, CD68, vimentin, and lysozyme.[12,32,44,51]

Imaging assessment modalities include computed tomography (CT) and magnetic resonance imaging (MRI). CT scan evaluates better periosteal reaction, pathologic fractures, and absence of matrix mineralization.[39] On the contrary, MRI provides better delineation of the tumor extension through the enhanced resolution acquired with contrast in different sequences.[12,32]

Treatment

GTR has been considered the main modality of treatment and warrants careful preoperative planning to provide the maximal extent of resection.[22,46,51] When GTR is not possible due to a risk of damaging vital structures or further impairment of the neurological function, subtotal resection (STR), radiotherapy (RT), chemotherapy (e.g., adriamycin, cisplatin, and doxorubicin), doxycycline sclerotherapy, denosumab, and bisphosphonates have been proposed as alternatives.[32] In our review of cases, the majority of patients that underwent either GTR or STR + RT did not present tumor recurrence during the follow-up.

GTR and RT are favorable factors for progression-free survival of intracranial GCTB.[29,51] Weng *et al*. recommended postoperative RT to patients with malignant pathology and Ki-67 index ≥10% regardless of the resection extent, residual tumors regardless of the Ki-67 index, and recurrent GCTB.[51] The radiation dose is variable in the literature; some authors reported reasonable control with 35Gy, >40 Gy, or ≥45Gy.[10,38,51] However, controversy still exists regarding the potential role of RT in the malignant sarcomatous transformation and the risk of recurrence.[10,20]

Denosumab, a monoclonal antibody, decreases osseous destruction by inhibiting RANKL-expressing cells.[18] It has been used as a neoadjuvant agent to decrease the tumor volume before surgical resection;[3,40] however, denosumab might obscure the histological features of GCTB and mislead the pathological diagnosis as a result.[14] On the other hand, Kajiwara *et al*. exemplified the use of denosumab as an adjuvant therapy to remove the remaining tumor when GTR was not achieved, which resulted in no recurrence of the tumor during a 5-year follow-up.[22]

Doxycycline sclerotherapy, adriamycin, and other chemotherapeutic agents have also shown to be effective when surgical resection is not possible, although in isolated cases.[52] Töret *et al*. reported the use of cisplatin and doxorubicin in a 10-day newborn with GCTB of the occipital bone, which had compromised vascular structures.[47] The treatment effectively reduced the tumor size, and the lesion did not recur at a 60-month follow-up. However, the recommendation for using chemotherapy in GCTB of the skull is not well-established and has not reached a consensus.

Zoledronic acid, a bisphosphonate agent, has been used less commonly in the skull compared to cases located in long bones.[36,56] Its anti-osteoclastic activity might constitute a helpful tool in controlling local recurrence, but widespread clinical use has not been recommended.

As a result of the unpredictable tumor recurrence even after surgical and nonsurgical modalities of treatment, patients must undergo close surveillance with follow-up MRIs every 3–6 months for the first 5 years, for example.[51]

CONCLUSION

GCTB rarely originates in the skull, being the occipital bone the most infrequent site of presentation. The gender distribution of this tumor in the skull is equal among adults; however, in the occipital area, females are more commonly affected. Besides, risk factors are still unknown and merit further investigation. A thorough clinical history, brain imaging, and histopathological analysis are essential for the diagnosis.

When feasible, total surgical resection effectively reduces the risk of recurrence. Nonetheless, radiation and adjuvant therapies have been employed when GTR could not be achieved. Ultimately, a close follow-up with brain MRIs is advised to control recurrence and further destruction of neighboring structures.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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