Chondroblastoma of the Clivus: Case Report and Review

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Abstract

Background and Importance   Chondroblastoma is a benign primary bone tumor that typically develops in the epiphyses of long bones. Chondroblastoma of the craniofacial skeleton is extremely rare, with most cases occurring in the squamosal portion of the temporal bone. In this report, we describe the first case of chondroblastoma of the clivus presenting with cranial neuropathy that was treated with endoscopic endonasal resection. We review the literature on craniofacial chondroblastomas with particular emphasis on extratemporal lesions.

Case Presentation   A 27-year-old woman presented with severe headache, left facial dysesthesias, and diplopia. Physical examination revealed hypesthesia in the left maxillary nerve dermatome, and complete left abducens nerve palsy. Imaging demonstrated an expansile intraosseous mass originating in the upper clivus with extension superiorly into the sella turcica and laterally to involve the medial wall of the left cavernous sinus. The tumor was completely resected via an endoscopic endonasal approach, with postoperative improvement in lateral gaze palsy. Histopathology was consistent with chondroblastoma.

Keywords
► chondroblastoma
► clivus
► endoscopic endonasal approach
► clival tumor

Conclusion   Chondroblastoma is a rare tumor of the craniofacial skeleton that should be included in the differential diagnosis of an osteolytic lesion of the clivus. Complete surgical resection remains the mainstay of treatment.

Introduction

First described by Codman in 1931, chondroblastoma is a rare benign tumor that accounts for 1% of all primary bone neoplasms.[1–3] These lesions typically originate from chondroblasts within the epiphyses of long bones, and are most common in the proximal humerus, distal femur, or proximal tibia.[4] Chondroblastoma usually presents in the second de-

cade of life, with a 2:1 male predominance, and causes localized swelling and pain that is managed with surgical resection and reconstruction.[5,6]

Chondroblastoma of the craniofacial skeleton is particularly rare, most frequently occurring within the squamous portion of the temporal bone.[5,7,8] To date, only 20 extratemporal chondroblastoma of the craniofacial skeleton have been reported, typically presenting in the third decade of life with

local mass effect and possible cranial neuropathy. We report the first case of chondroblastoma of the clivus causing diplopia that was resected via an endoscopic endonasal approach.

Case Report

Clinical History

A 27-year-old woman with an 18-month history of headache and intermittent diplopia presented to the hospital with a 48-hour history of severe headache, persistent diplopia, and left facial dysesthesias. Physical examination revealed hypesthesia in the left maxillary nerve dermatome, and complete left abducens nerve palsy with esotropia.

A computed tomography (CT) scan of the head demonstrated an expansile intraosseous mass of the upper clivus, measuring 28 × 20 × 19 mm (►Fig. 1A). The mass was relatively well circumscribed, contained multiple scattered foci of punctate calcifications, and resulted in erosion of the posterior cortex of the clivus and of the medial cortex of the carotid canal. It caused effacement of the prepontine cistern and mild narrowing of the internal carotid artery (ICA) as demonstrated by CT angiogram (►Fig. 1B).

On magnetic resonance imaging (MRI), the mass was isointense to gray matter on T1-weighted sequences, markedly hypointense on T2-weighted sequences, and diffusely but mildly enhancing after gadolinium administration (►Fig. 1C and 1D).
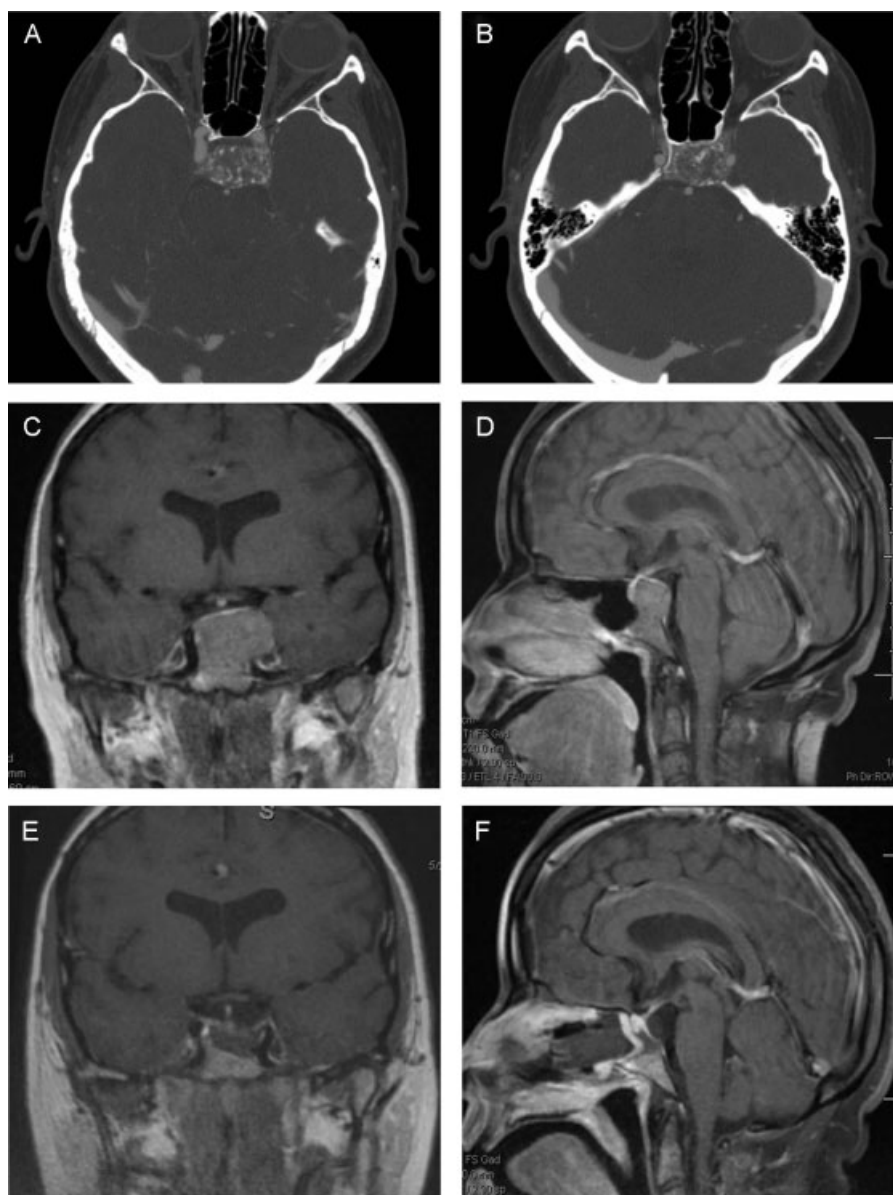

Fig. 1 Preoperative CTA demonstrating calcified expansile lesion of the upper clivus and posterior sella turcica, with compression of the left cavernous sinus (panel A) and erosion of the carotid canal along its vertical clival segment (panel B). Preoperative coronal (panel C) and sagittal (panel D) gadolinium-enhanced MRI demonstrating a homogenously enhancing expansile lesion of the middle and upper clivus with anteriosuperior deviation of the pituitary gland and compression of the left cavernous sinus. Immediate postoperative MRI scans demonstrates gross-total resection of tumor (panel E), with decompression of the pituitary gland and stalk (panel F). CTA, computed tomography angiography; MRI, magnetic resonance imaging.

The mass extended laterally to the medial wall of the left cavernous sinus resulting in mild mass effect on the cavernous segment of the left ICA. It also eroded the floor of the sella turcica and extended into the sella and suprasellar cistern causing superoanterior deviation of the pituitary gland but no mass effect on the optic chiasm. There was mild effacement of the prepontine cistern, with encroachment on the basilar artery and with no clear involvement of the Dorello canal.

The patient received high-dose dexamethasone and was scheduled for an urgent operation.

Surgery

A direct endoscopic endonasal approach was used to perform a right middle turbinectomy, nasoseptal flap elevation, posterior septectomy, posterior ethmoidectomy, and wide sphenoidotomy. Surgical navigation was used to identify the tumor margins and confirm adequate surgical exposure. Intraoperative Doppler ultrasound and surgical navigation were also used to identify the location of the paraclival/vertical segment of each ICA before beginning the resection.

A high-speed drill and rongeurs were used to remove the anterior face and floor of the sella turcica, as well as the anterior clivus overlying the lesion. Tumor tissue was encountered within the clivus bone, which was resected in a piecemeal fashion. Tumor was found to extend through the posterior margin of the clivus, abutting but not transgressing the dura, which appeared grossly normal (►Fig. 2). Lateral extension of the tumor behind the left paraclival ICA was removed using suction and angled ring curettes. Inferior extension into the clivus was drilled out, and superior extension through the floor of the sella turcica and behind the pituitary fossa dura was resected using suction and angled ring curettes. Along the posterior floor of the sella, at the junction with the prepontine dura at the clival recess, there was a small dural defect overlying the gland where tumor had invaded some of the dura but had not extended into the pituitary gland—this was completely resected without complication and no visible cerebrospinal fluid (CSF) leak was present.

After completing the tumor resection, we elected to place the nasoseptal flap over the repair given the wide area of mucosal resection required for tumor access and to mitigate the risk of delayed CSF leak from the small dural defect noted above. The nasoseptal mucosal flap was secured in place using DuraSeal (Covidien Ltd., Mansfield, MA) and buttressed with a posterior nasal packing. The patient was extubated in the operating room and transferred to the intensive care unit for postoperative care.

Postoperative Course

The patient's immediate postoperative course was uncomplicated, with mild improvement in her left lateral gaze palsy. Immediate postoperative MRI scan confirmed complete removal of the tumor, with preservation of the pituitary gland and prepontine dura (►Fig. 1E, F). She did not demonstrate any clinical signs of pituitary dysfunction during the perioperative period. After 3 weeks of surgery, the patient continued to experience moderate sixth nerve palsy that was managed with prism lenses in her eyeglasses. The patient's diplopia and facial dysesthesias fully recovered 3 months after surgery. Adjuvant therapy was not employed since a complete excision was achieved.

Histopathology

Grossly, the lesion was red-tan with areas of granular calcifications. Microscopically, the tumor was composed of uniform round to polygonal cells with well-defined cytoplasmic borders, round to ovoid nuclei, predominantly growing in cellular sheets (►Fig. 3A, B). There were scattered osteoclastic giant cells. Pericellular "chicken wire-like" calcifications were identified (►Fig. 3C) pathognomonic of chondroblastoma.

Tumor cells were focally positive for S-100 and proliferative activity was estimated to be 5 to 10% (►Fig. 3D). These findings were consistent with a histopathologic diagnosis of chondroblastoma.
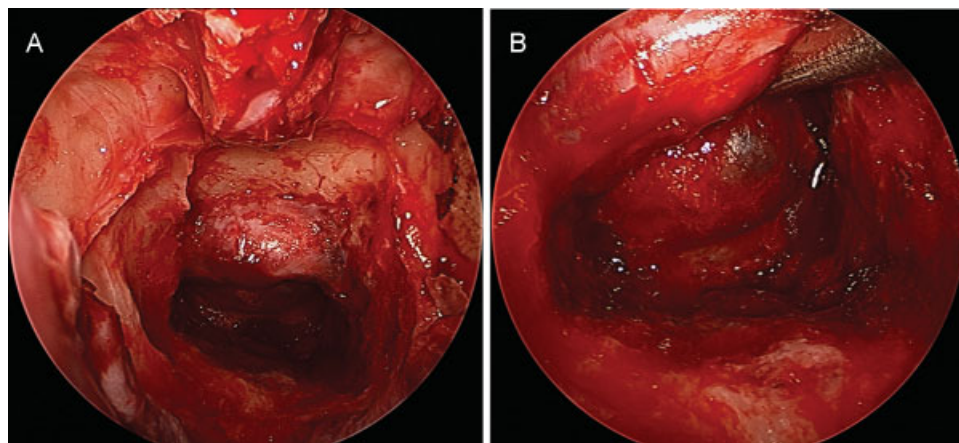

Fig. 2 Endoscopic view of the sphenoid sinus after resection of the clivus mass (panel A). The tumor occupied the middle and upper clivus, with anterior extension to, but not into, the prepontine dura (panel B).
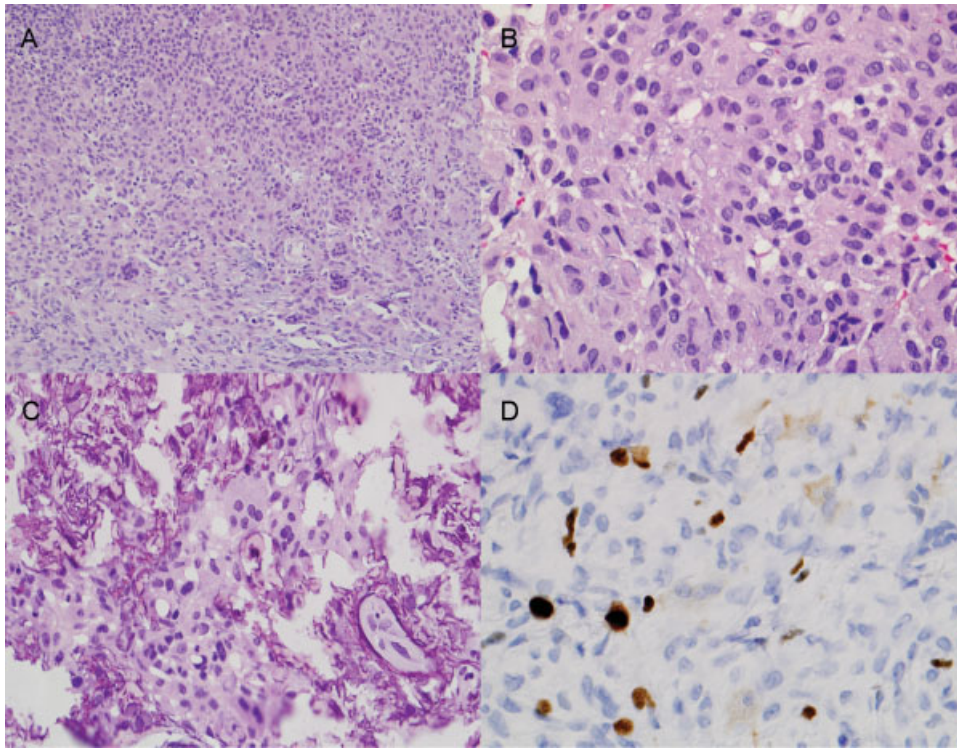
Fig. 3 (Panel A) Chondroblastoma composed of sheets of mostly uniform appearing chondroblasts and scattered osteoclast-type giant cells, H&E, ×200 magnification; (panel B) H&E, ×400 magnification; (panel C) pericellular "chicken wire" calcifications, H&E, ×400 magnification; (panel D) proliferative K_i-67 activity, ×400 magnification. H&E, hematoxylin and eosin.

Discussion

Chondroblastoma occurring outside of the epiphyses of long bones is rare, with lesions of the craniofacial skeleton accounting for 6.6 to 7.1% of all cases.[1,2,9] The mean age of presentation is 39.4 years, significantly older than patients with long bone disease.[5,10,11] Signs and symptoms of craniofacial chondroblastoma vary based on anatomic location, often resulting from mass effect on adjacent structures. For example, lesions of the temporal bone often present with hearing loss (49%), cranial neuropathy (43.3%), facial swelling (22.2%), and/or otalgia (19.8%).[8,12–18] Since the abducens nerve is particularly prone to compression at the clivus where it enters the Dorello canal,[19] chondroblastoma in this region can result in diplopia with lateral rectus palsy and headache.

The squamous portion of temporal bone is the most common site of craniofacial chondroblastoma, likely due to its cartilaginous origin.[10,17,18] Reid et al identified 81 total reported temporal bone cases since 1950.[12] Only 24 extratemporal craniofacial lesions have been reported previously, including chondroblastoma in the region of the temporomandibular joint ($n = 13$), the nasal cavity and paranasal sinuses ($n = 5$), skull base ($n = 1$), skull vault ($n = 4$), and nasion ($n = 1$, see ►Table 1).[1,6,9,20–32]

In 1978, Harner et al postulated that chondroblastoma results from a transition incident during cartilaginous or endochondral bone formation.[33] In 1992, Varvares et al further theorized that chondroblastomas arise from normal chondrocytes that transform in response to an alteration in the local environment.[34] For example, such an initiating event can occur when normal mesenchymal or cartilaginous tissue is trapped within the petrosquamous suture line during temporal bone development.[35,36] The petrosquamous suture delineates the embryologically distinct squamous and petrous portions of the temporal bone, making this theory plausible.[35] Expanding on the above theory, it is possible that chondroblastoma of the clivus originates from the cartilaginous union of the sphenoid body and basilar part of the occipital bone, or from cells trapped within the sphenooccipital synchondrosis.[37]

The three hallmark histopathological features of chondroblastoma are mononuclear cells (chondroblasts), osteoclastic-like giant cells, and a chondromyxoid stroma surrounding neoplastic cells.[12,38,39] In general, chondroblastomas display low proliferative activity.[18,40] High mitotic activity, however, has been described by Ishikawa et al in an aggressively growing temporal bone chondroblastoma with a high MIB-1 index.[40]

Chondroblastoma must be differentiated from other giant cell tumors. The osteoclastic-like giant cells seen in chondroblastomas can have striking histological similarities to giant cell reparative granulomas, aneurysmal bone cysts, giant cell tumors, and chondromyxoid fibromas. Positive staining for S-100 is most commonly used to help differentiate from other giant cell tumors, since this protein is expressed on human chondrocytes and related to chondroid tissue formation.[22,41]

Radiographically, chondroblastoma of the long bone presents as a well-demarcated, round-to-ovoid lytic lesion,

Table 1 Summary of extratemporal craniofacial chondroblastoma case reports

Authors and year	Location of mass	Age (y), sex	Presentation	Management	Radiographic evidence of growth	Symptom duration	Follow-up (mo)	Outcome
Lee et al, 1976	Anterior clinoid	13, M	Headache, oculomotor nerve palsy	Surgical resection	Yes	2 y	NR	NR
Al-Dewachi et al, 1980	Maxilla	13, F	Painless mass	Surgical resection	Yes	4 mo	8	NED
Badia et al, 1985	Maxilla	17, F	NR	Surgical resection	Yes	NR	6	NED
Martinez-Madrigal et al, 1991	Maxilla	14, F	Nasal obstruction, epistaxis, exophthalmos	Surgical resection	Yes	2 mo	NR	NR
Burgin et al, 2010	Sphenoid sinus	30, F	Headache	Surgical resection (endonasal)	Yes	NR	6	Tumor left on ICA
Cabrera et al, 2006	TMJ region	31, M	Swelling over preauricular area	Surgical resection	Yes	3 y	12	NED
Cabrera et al, 2006	TMJ region	38, F	Painless mass	Surgical resection	Yes	2 y	NR	NED
Ohnishi et al, 1985	Occiput	14, M	Headache, loss of consciousness	Surgical resection	Yes	1 d	36	NED
Araújo et al, 1995	Occiput	16, F	Vertigo, ataxia	Surgical resection	Yes	2 mo	24	NED
Goodsell et al, 1964	Mandible	41, M	Swelling of temporal region	Surgical resection	Yes	2 y	32	Recurrence
Milazzo et al, 1967	Mandible	28, M	Swelling of mandible	Surgical resection	No	2 y	24	NED
Bertoni et al, 1987	Mandible	42, M	Pain	Surgical resection	No	2 y	156	NED
Bertoni et al, 1987	Mandible	58, M	Pain	Surgical resection	No	NR	NR	NR
Bertoni et al, 1987	Mandible	43, F	Swelling	Surgical resection	No	2 y	NR	NR
Bertoni et al, 1987	Mandible	37, M	Pain	Surgical resection	No	3 y	48	NED
Bertoni et al, 1987	Mandible	22, F	NR	Surgical resection	No	NR	44	NED
Bertoni et al, 1987	Mandible	44, M	NR	Surgical resection × 2	No	NR	NR	NR
Bertoni et al, 1987	Mandible	19, M	Pain and swelling	Surgical resection	No	1 mo	2	NED
Payne et al, 1987	Mandible	33, F	Pain	Surgical resection	Yes	3 y	NR	NED
Kondoh et al, 2002	Mandible	27, F	Malocclusion, trismus	Surgical resection	Yes	2 y	144	NED
al-Sader et al, 1996	Nasal bridge	15, F	Swelling over nasal bridge	Surgical resection	No	NR	12	NED
Bertoni et al, 1987	Parietal bone	26, F	Painless mass	Surgical resection	No	7 y	96	NED

Table 1 (*Continued*)

Authors and year	Location of mass	Age (y), sex	Presentation	Management	Radiographic evidence of growth	Symptom duration	Follow-up (mo)	Outcome
Dahlin et al, 1972	Parietal bone	NR	Swelling	NR	No	NR	NR	NR
Miyake et al, 1984	Nasal cavity/ frontal region	1.7, F	Seizure	Surgical resection	Yes	NR	NR	NR

Abbreviations: ICA, internal carotid artery; NED, no evidence of disease; NR, not reported; TMJ, temporomandibular joint.

occasionally containing calcific foci (range, 30–50%).[2,22,42] In the temporal bone, these lesions can be solid or cystic, with an osteolytic appearance and areas of punctate calcifications (as was present in the case we present).[5,8,10,11,13,16,43]

MRI findings are more variable—lesions are often low-to-intermediate intensity on T1-weighted sequences and low-to-high intensity on T2-weighted MRI[5,10] and demonstrate contrast enhancement, which can be peripheral, homogeneous, or heterogeneous.[10,40,44] The clival lesion we present appeared intermediate intensity on T1-weighted and low intensity on T2-weighted sequences, consistent with endochondral bone formation and cartilaginous tumor matrix rather than chronic blood products.[5]

The differential diagnosis for an expansile clival mass, such as in our patient, includes chondrosarcoma, chordoma, plasmacytoma, and much less likely chondromyxoid fibroma. Presence of chondroid matrix excludes chordoma and plasmacytoma. Chondrosarcoma, the most frequent clival chondroid mass, cannot be reliably differentiated by imaging from chondroblastoma and chondromyxoid fibroma.

Management Strategies

Since chondroblastoma is a benign locally aggressive tumor, complete excision is the mainstay of treatment.[12,41,45,46] Simple curettage is not adequate, as it has been associated with a recurrence rate of 55%.[2,47] Kurokawa et al and Moon et al found no evidence of recurrence 5 and 9 years after following complete en bloc resection of temporal bone chondroblastoma.[46,47] However, some authors have reported recurrence rates approaching 20%, even after complete tumor removal.[4,10,17] Therefore, surveillance imaging following surgical resection is prudent for early diagnosis of tumor recurrence.

There is insufficient data to predict tumor behavior in craniofacial chondroblastoma. Malignant degeneration to chondrosarcoma is likely rare but has been previously reported,[11] and some authors have suggested that lesions with an intratumoral aneurysmal bone cyst may behave more aggressively.[8]

Radiation therapy is a treatment option for poor surgical candidates, or patients with recurrent or unresectable disease.[11,41] Radiation is not recommended after complete excision, due to the possibility of radiation-induced chon-

drosarcoma.[41] Metastatic workup is not recommended since metastatic craniofacial chondroblastoma has never been reported (in contrast, pelvic chondroblastoma may spread to the abdomen and lung).[12,48] At present, there is no role for chemotherapy in the management of chondroblastomas.[11]

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