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CASE REPORT

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Cloaked up osteosarcoma: chondroblastoma-like osteosarcoma — a case report and literature review

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Abstract

Osteosarcoma (OS) is the most common nonhematopoietic bone malignancy. Chondroblastoma-like osteosarcoma is an extremely uncommon variant with only 26 cases reported in medical literature in English. Given its rarity, diagnosis and management can be challenging. Osteosarcoma patients frequently receive inadequate care and incorrect diagnoses, which can lead to recurrences. Hereby, we report a rare case of osteosarcoma in an untypical location with a review of the literature. The case of an 18-year-old male with chondroblastoma-like osteosarcoma in the body of the sternum highlights diagnostic pitfalls and emphasizes the importance of morphology.

Keywords: chondroblastoma-like osteosarcoma, aggressive chondroblastoma, osteosarcoma of sternum

Introduction

Osteosarcoma (OS) is the most common primary nonhematopoietic malignant bone tumor [1–3]. The term osteosarcoma has been defined as a high-grade bone tumor in which tumor cells produce osteoid or woven bone. Osteosarcomas have multiple described, histological and anatomical variants, including conventional OS (osteoblastic, chondroblastic, and fibroblastic OS), small cell, telangiectatic, giant cell-rich variants, and others [1–3]. However, this rare entity identified as chondroblastoma-like osteosarcoma (CBLOS), which accounts for fewer than 1% of all osteosarcomas, has unique histological and clinical characteristics. This disparate entity needs to be distinguished from chondroblastic OS and chondroblastoma, which are two closely related yet distinct entities. In the English medical literature, there are not many case reports or brief case series. Usually affecting bones of the foot, osteosarcomas seem to affect predominantly young individuals. As far as we understand, there are no case reports of these tumors emerging from flat bones. We have reviewed the literature, and hereby report a case of an 18-year-old male, with this exceptionally rare malignancy of bone in an uncommon site. The significance of using relevant diagnostic imaging and identifying histological features in establishing the diagnosis of CBLOS is highlighted based on our experience.

Case report

An 18-year-old male patient presented with swelling and pain in the anterior part of the chest which increased during coughing or heavy breathing. He had no history of chronic disease. Physical examination revealed a bulge over the sternum measuring 5 × 3 cm, which was fixed, nontender, and hard in consistency.

The findings from the computed tomography (CT) scan of the chest and abdomen showed an expansile lesion involving the body of the sternum measuring 4.3 × 4.6 × 7.1 cm, with an enhancing soft tissue component within the lesion showing significant rings and arc type of calcification and multiple areas of the cortical breach, with an extension of soft tissue into subcutaneous and muscular planes. Posteriorly, the lesion was abutting the pericardium with no obvious invasion. No intrathoracic extension was identified (Fig. 1). With these findings, a radiological suspicion

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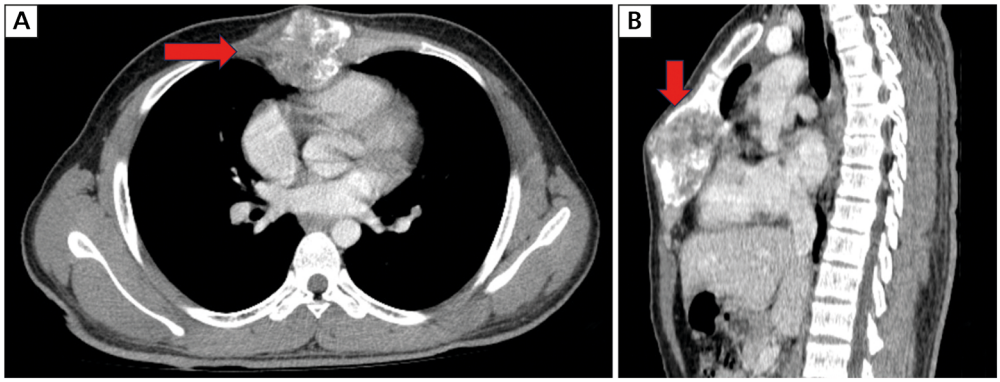

Figure 1. Computed tomography (CT) chest — expansile lesion involving the body of sternum (marked by red arrow) with an enhancing soft tissue component within the lesion showing significant rings and arc type of calcification and extension into adjacent soft tissue; **A.** Coronal; **B.** Sagittal

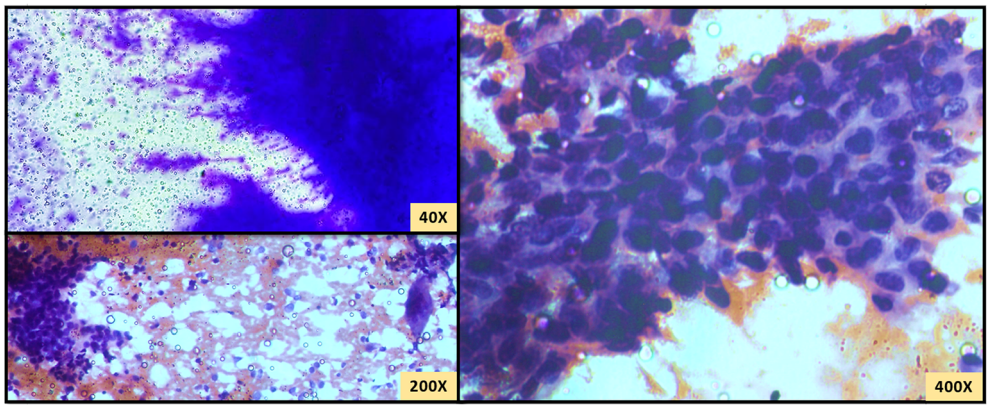

Figure 2. Fine needle aspiration smears of sternal lesion – Shows clusters as well as dispersed tumor cells exhibiting grooving with interspersed osteoclast-type giant cells embedded in chondroid matrix like background material

of expansile bone neoplasm with chondroid matrix arose. However, a conclusive opinion could not be provided.

Fine needle aspiration was performed from the lesion, which showed a giant cell-rich cartilaginous neoplasm with tumor cells in clusters, exhibiting ovoid and polygonal cells with fine chromatin and occasional grooves. Many osteoclast-type giant cells were observed. A focally chondroid-like matrix was noted (Fig. 2). A needle core biopsy (Jamshidi needle) was performed. Histologically, the tumor tissue displayed a cellular neoplasm composed of round-to--polygonal cells exhibiting nuclear grooves with moderate cytologic atypia, arranged in lobules and sheets intervened by scattered osteoclastic type of giant cells. Chicken wire-like calcification was noted with cartilaginous areas. No malignant osteoid was identified. The lesion was suggestive of a chondroblastoma. Further, we performed Immunohistochemistry for confirmation, which showed positivity for DOG1 and a low KI67 proliferation index (7%). Though this needle core biopsy was not representative of the lesion, the possibility of aggressive chondroblastoma was considered, keeping in mind the location and radiological findings.

Given the aggressive radiological picture exhibiting soft tissue and muscular plane involvement, sternal resection with chest wall reconstruction using a titanium mesh was done. On gross examination, a grey--white tumor measuring $7.5 \times 4.5 \times 4$ cm was identified in the body of the sternum, which was gritty to cut along, with areas of necrosis and hemorrhage.

Histopathological examination of the sternal resection showed similar features to the J-needle biopsy performed earlier, with an infiltrative growth pattern toward the soft tissues, moderate anaplasia of the tumoral cells, and lace-like malignant osteoid (Fig. 3). A final diagnosis of chondroblastoma-like osteosarcoma was confirmed. The histopathological report confirmed soft tissue involvement; however, it had tumor-free margins all over the specimen. The specimen was assigned a TNM stage of pT1 [8^{th} edition TNM staging system for bone tumors of the American Joint Committee on Cancer (AJCC) and the International Union Against Cancer (UICC)].

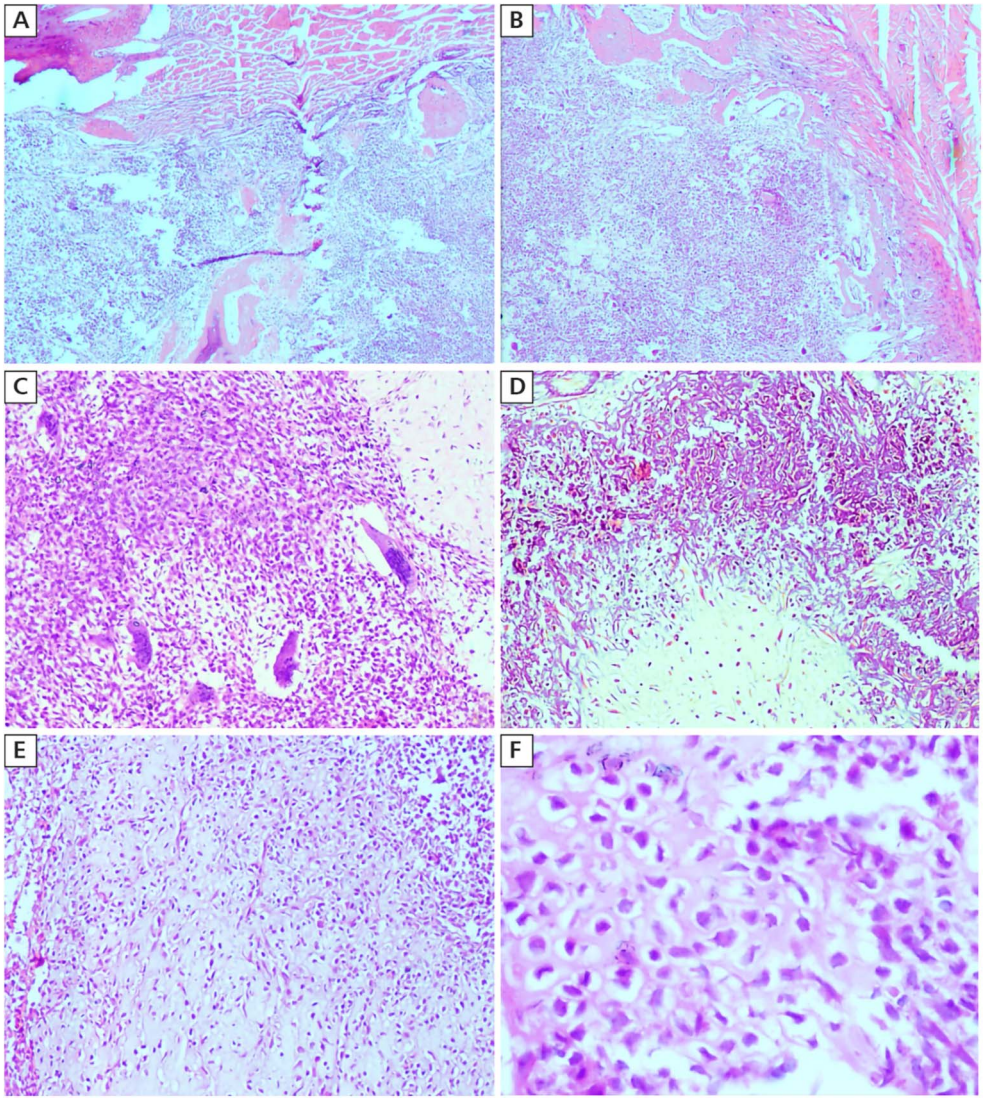

Figure 3. Chondroblastoma-like osteosarcomas, histology — infiltrative tumor involving soft tissue, muscular plane, and bone tissue (**A, B**), composed of round to oval cells with a grooved nucleus. Numerous scattered multi-nucleated osteoclast-like giant cells are noted (**C**) with a chicken-wire type of calcification (**D**). Tumor cells produce variable amounts of lace-like osteoid matrix (**E**) exhibiting moderate to severe nuclear atypia (**F**)

The postoperative period was uneventful with no complications or neurovascular deficits. At the end of 2 months, chest radiographs revealed an intact mesh with good osteointegration. (Fig. 4). The patient was started on adjuvant chemotherapy after 2 months of surgery i.e., adriamycin and cisplatin. We followed up with the patient for 16 months, and he was doing well and was disease-free.

Discussion

In children and young adults, OS are the most prevalent primary non-hematopoietic bone cancer [1–3]. They could be osteogenic, chondrogenic, or fibroblastic. In 1990, the term 'chondroblastoma-like osteosarcoma' was coined by Schajowicz et al. [4]. It is an extremely rare and little-known histological subtype of osteosarcoma, with just a handful of cases reported in English literature [4, 5]. The vast majority of the reported cases present in the 3rd decade of life. The most frequent sites of involvement are metatarsal bones (4 cases), femur (3), ribs (3), humerus (2), tibia (2), and single cases at the fibula, ischium, phalanx, talus, and ilium [4–6]. Unlike these previous case reports and series, this is the first case reported in the sternum. The majority of the reported CBLOS patients had a minor trauma after which they developed painless mass or pain [1–7]. The pain in our case was attributed to the site, as the sternum is the most sensitive site. The locations and radiological patterns of involvement by CBLOS are varied. The first case reported in 1990 was a 12-year-old male child who was diagnosed with CBLOS in the tibia [4].

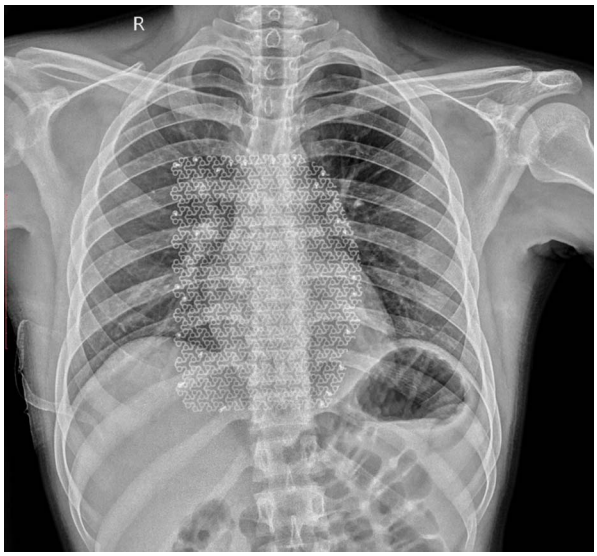

Figure 4. Chest X-ray (post sternal resection and reconstruction with mesh)

Chondroblastoma-like osteosarcoma has been radiologically described predominantly in the diaphysis of long bones exhibiting a mixed pattern composed of a lytic and sclerotic pattern, with either thin or absent cortices, and expansile radiolucent area, focal punctate calcifications leading to a laminar periosteal reaction and endosteal scalloping [4, 5]. Chondroblastoma-like osteosarcomas also involve soft tissues and have a destructive penetration of the host bone, as demonstrated by radiology [6–8]. Radiologically, chondroblastoma-like osteosarcoma was previously described as an expansile lytic lesion with endosteal erosions and focal punctate calcifications. It was observed that the entire bone was affected in those with metatarsal involvement. Differential diagnosis with use of radiology includes considering giant cell tumors [7–9], aneurysmal bone cysts [7, 9, 10], chondromyxoid fibroma [11] and chondroblastoma, Ewing sarcoma, fibrous dysplasia, chondrosarcoma, Langerhans cell histiocytosis. We had similar differentials in our case, but we did not take into account the aggressive nature of the tumor The cases that have been reported in the English literature are summarized in Table 1 [4, 6, 7, 9–12].

Table 1. Literature review

No.	Source, year	Age [years]/ /sex	Site	Size	Radiological features	Treatment	Follow-up
1.	Schajowicz et al. [4], 1990	12/M	Tibia	NA	NA	NA	NA
2.	Bahrami et al. [6], 2010 — 17 cases	13–72/M, 8/F	Metatarsus (3) Femur (3) Rib (3) Humerus (2) Talus (1) Phalanx (1) Tibia (1) Fibula (1) Ischium (1) Ilium (1)	NA	13/14 malignant or with suspicion of malignancy 1/14 equivocal	NA	7 ANED 6 LR 2 Metastasis 2 DOD
3.	Byatnal et al. [7], 2013	17/M	Jaw	6 cm	NA	NA	NA
4.	Martin et al. [9], 2014	32/M	Distal tibia	NA	GCT	Curettage followed by resection	12 years, multiple LR
5.	Aycan et al. [10], 2015	10/M	First metatarsal		GCT versus ABC	Resection	ANED 6 months
6.	Ramos Pascua et al. [11], 2018	30/M	Tibia	6 cm	Benign versus malignant	Aggressive curettage	ANED 7 years
7.	Gaeta et al. [12], 2022 — 6 cases	20/M 9/M 63/F 54/M 14/M 14/M	1st metatarsal 1st metatarsal Scaphoid VI rib Vertebra 3rd metacarpel	NA	2/6 malignant or with suspicion of malignancy 4/6 Equivocal	4/6 Wide resection 1/6 Marginal Resection 1/6 Curretage	4 ANED 1 LR 1 DOD
8.	Current case	18/M		7.5 cm	Equivocal	Resection	ANED 30 months

ABC — aneurysmal bone cyst; ANED — alive with no evidence of disease; DOD — died of disease; F — demale; GCT — giant cell tumor; LR — local recurrence; M — male; NA — not available

Chondroblastoma-like osteosarcoma has a presentation similar to that of osteosarcoma, however, it has a younger age of presentation than malignant chondroblastoma [6]. Bahrami et al. [6] reviewed 17 CBLOS cases; two patients had recurrence, and one of them developed recurrence over 14 years after initial resection. Two patients died of disease, one due to local recurrence in the cervical C7 vertebra, and one had widespread metastases over 26 years. This behavior of this type of osteosarcoma contrasts with that of conventional osteosarcoma, which is known to have a worse prognosis and faster disease progression when associated with metastases. Our patient also underwent morbid surgery amounting to complete resection of sternum along with the tumor. However, the patient responded well, with no recurrence or metastasis in the sixteen-month follow-up period.

Although chondroblastoma-like osteosarcoma is a completely distinct entity from chondroblastoma, we shall discuss them together as chondroblastoma--like osteosarcoma has a significant historical and morphologic relationship to chondroblastoma. It was first described in 1990 by Schajowicz et al. [4] who coined the term chondroblastoma-like osteosarcoma. Despite being called chondroblastoma, it is a rare variant of osteosarcoma.

Clinically, the tumor presents mostly in males, of a wide age range, and has an indolent course, with only a minority of the reported cases developing pulmonary metastases and local recurrences [9]. This neoplasm has a predilection for the lower extremities, most commonly involving the metatarsus, tibia, and femur. Our case, however, had sternal pain and swelling on a flat bone — the sternum.

Radiologically, most of the cases reveal findings that are suggestive of or consistent with malignant tumors. This tumor is known to show lesions that are 'expansile and lytic, with an infiltrative growth pattern; destroying cortical bone'. Aneurysmal bone cysts, chondroblastomas, giant cell tumors, and chondrosarcoma are among the radiological differential diagnoses [4, 5, 7, 8]. Our case had an expansile sternal tumor with the destruction of soft tissue and muscular planes, implying an aggressive growth pattern. However, the findings did not classically correspond to an osteosarcoma and were leaning more toward a chondroblastoma with aggressive growth.

Histologically, this distinct neoplasm is characterized by hypocellular and hypercellular areas. The cellular areas resemble the features of chondroblastoma with abnormal malignant osteoid deposition and destruction of the adjacent nonneoplastic bone [6]. The tumor has an 'infiltrative growth pattern composed of small cells exhibiting ovoid, folded, or grooved nuclei with eosinophilic pale cytoplasm, resembling the neoplastic cells enmeshed in chondroid matrix observed in chondroblastoma along with varying amounts of chicken wire calcification.' In addition, it also has areas with larger cells displaying more nuclear atypia, with few atypical mitotic figures and evidence of malignant osteoid deposition [4, 5, 7–9]. Our case displayed the described features of chondroblastoma with the unique features pertaining to CBLOS exhibiting interspersed islands of plasmacytoid, polygonal osteoblasts, and areas of malignant lace-like osteoid deposition.

The largest reported study by Bahrami et al. and a review of CBLOS by Hmada et al. [8] included, respectively, 17 patients and 22 patients. In the study by Bahrami et al. [6], 10 of the 17 patients had available follow-up information: '2 had died from the disease, 2 had developed lung metastases, and 6 of them had local recurrence'. In the study by Hmada et al. [8], the authors reviewed 5 cases in addition to the 17 cases reported by Bahrami et al. [6]. Three patients had follow-up data, and only one of them developed local recurrence.

The primary differential diagnosis for CBLOS is chondroblastoma, which is a benign neoplasm with cartilage production that is mostly seen in the second decade of life. It is located in an epiphyseal region or metaphyseal/epiphyseal region of the long bones. The characteristics that point towards CBLOS are older age and usually non-epiphyseal location (although it can be epiphyseal) [4, 6, 7], with histopathological characteristics in addition to the chondroblastoma. These are malignant osteoid production/formation, nuclear atypia, and increased and atypical mitoses, with destructive permeation resulting in bone/soft tissue infiltration and, tumor necrosis [4, 6, 7]. On the other hand, conventional chondroblastic OS is less likely to be misdiagnosed as CBLOS, as it presents with deposition of high-grade hyaline cartilage that exhibits severe atypia and lacunae [1]. Chondrosarcoma, which again displays hyaline cartilage matrix deposition with malignant chondrocytes exhibiting significant nuclear atypia that reside in lacunae [1], would not be considered a differential in histopathological diagnosis. As we know, the histological picture has to be correlated with radiological and clinical findings to include or rule out the possibility of CBLOS. The comparison of clinical, radiological, and histopathologic characteristics of chondroblastoma, malignant chondroblastoma [13, 14], and CBLOS is presented in Table 2.

Gaeta et al. [12] studied clinicopathologic and molecular data of 6 cases of CBLOS and compared these with 6 cases of chondroblastoma with atypical features. Immunohistochemistry (IHC) for H3.3 K36M and H3.3 G34W can be used to differentiate chondroblastoma and giant cell tumor respectively. Molecular profiling by whole exome sequencing (WES) was performed on two of the CBLOS and

Table 2. Comparison of chondroblastoma (CB), malignant chondroblastoma, and chondroblastoma-like osteosarcoma (CBLOS)

Characteristics	Chondroblastoma	Malignant chondroblastoma	Chondroblastoma-like osteosarcoma
Clinical	Typically affects individuals in the second decade of life Predominantly presents with localized pain, often centered around the affected joint Benign behavior with a low rate of metastasis	Occurs in older age groups compared to conventional CB Presents with persistent or worsening pain and may exhibit signs of local invasion Characterized by a more aggressive clinical course, including a higher risk of recurrence and metastasis.	Occurs at the intermediate age range between CB and malignant CB Clinical presentation may resemble CB but with a higher tendency for aggressive behavior. However, better prognosis compared to malignant CB and conventional osteosarcoma
Radiological	Well-defined, eccentrically located lytic lesions with sclerotic margins on plain radiographs May demonstrate lobulated or soap-bubble appearances	Radiographic features include permeative bone destruction, cortical breach, and soft tissue extension Aggressive appearance with a higher likelihood of associated soft tissue masses	Radiologically heterogeneous, combining features of chondroblastoma and osteosarcoma Presence of both lytic and sclerotic components, as well as areas of mineralization and osteoid formation
Histopathological	Sheets of round to polygonal cells with eosinophilic cytoplasm Central nuclei and characteristic "chicken-wire" calcifications in hyaline cartilage	Increased cellularity, nuclear atypia, and mitotic figures Necrosis may be present, indicating aggressive behavior	Combination of chondroblastoma-like areas and osteosarcomatous components Presence of malignant osteoid and cartilaginous matrices
H3.3 K36M point mutation	Present (~95%)	Absent	Absent

11 conventional high-grade osteosarcomas to compare them. The authors found that H3.3 K36M was positive in 2 of the 6 cases. In the limited two cases of WES by next-generation sequencing, they identified that CBLOS share a similar appearance to conventional high-grade osteosarcomas, with RTK-RAS, NOTCH, and Hippo being the significant oncogenic pathways involved. A point mutation in histone H3.3 K36M is identified in 95% of chondroblastomas [15, 16]. As far as we are aware, no credible reports of H3K36M have been found in tumors other than chondroblastoma, even though the Catalogue of Somatic Mutations in Cancer (COSMIC) database contains more than a million tumors [17]. Therefore, it seems that a positive H3K36M IHC test will almost always rule out a malignant chondroblastoma and CBLOS in differential diagnosis.

Conclusions

Despite osteosarcomas being extremely unusual, one should take into account chondroblastoma-like osteosarcoma when considering differentials for chondroblastoma and chondroblastic OS, especially when radiological features are atypical and the lesion is aggressive. Awareness of this entity can facilitate timely and effective intervention that will improve patient prognosis as CBLOS are known to have an indolent course.

Article Information and Declarations

Ethics statement

Consent was obtained from patient.

Author contributions

S.S.: collection of case details and writing manuscript; P.J: collection of case details; S.M.N., C.G.: supervision and review of manuscript.

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Conflict of interest

All authors declare no conflict of interest.

Supplementary material

None.

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