Case report of epithelioid osteoblastoma of the mandible: findings on positron emission tomography/computed tomography and review of the literature

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Epithelioid osteoblastoma is a clinically aggressive subtype of osteoblastoma that favors the mandible and the maxilla. Its histologic features lie on a spectrum between conventional osteoblastoma and low-grade osteosarcoma, thus making it difficult at times to confirm the diagnosis. It is known to have a high risk of recurrence after surgical resection, but it is a benign entity and does not have the propensity to metastasize. To our knowledge, there are no published reports on findings of epithelioid osteoblastoma on positron emission tomography/computed tomography (PET/CT). We report a case of a 25-year-old male patient with a diagnosis of epithelioid osteoblastoma of the mandible. The lesion exhibited significantly increased fluorodeoxyglucose uptake on PET/CT with a maximum standardized uptake value of 5.5. PET/CT is not specific in differentiating between malignant and benign bone lesions but may be necessary to rule out distant lesions when a confirmed diagnosis of epithelioid osteoblastoma cannot be obtained through histologic examination. (Oral Surg Oral Med Oral Pathol Oral Radiol 2019;128: e16–e20)

Osteoblastoma is a relatively uncommon benign bone tumor that accounts for less than l% of primary osseous tumors.[1] It most commonly appears during ages 10 through 40 years and has a predilection to develop in the spine and long bones. Approximately 15% of cases arise in the cranial bones, maxilla, and mandible. On gross pathology, osteoblastoma appears red to reddish brown in color. Microscopically, it has a well-vascularized matrix, with irregularly shaped lamellae of osteoid and bone and a prominent rim of osteoblasts. These microscopic findings are almost identical to those of osteoid osteoma.[2]

In 1967, Mayer first described a subtype of osteoblastoma referred to as "aggressive osteoblastoma," and it was distinguished from conventional osteoblastoma because of the presence of prominent epithelioid osteoblasts.[3] This subtype has also been referred to as "pseudomalignant osteoblastoma," "malignant osteoblastoma," and "osteoblastoma-like osteosarcoma."[2,4,5] but the term recommended by World Health Organization in their latest series of *WHO Classification of Tumors* is "epithelioid osteoblastoma."[6] In 1984, Dorfman et al.[7] further defined this subtype as having features resembling those of osteoblastoma and low-grade osteosarcoma, as well as low mitotic activity but no atypical mitosis. Furthermore, epithelioid osteoblastoma is known to have a high risk of recurrence after surgical resection, but no propensity to metastasize; however, some controversial cases of aggressive osteoblastoma transforming to osteosarcoma have been described in the literature.[7,8]

Osteoblastoma has markedly elevated uptake on fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (18F-FDG PET/CT) to a level that resembles malignant tumors.[9-12] Yet, to the best of our knowledge, no paper has described the findings on 18F-FDG PET-CT of the epithelioid osteoblastoma subtype. In this paper, we present the clinical, histologic, and radiologic findings of a case of epithelioid osteoblastoma located in the mandible. Written informed consent was obtained from the patient for the publication of this case report.

BACKGROUND

A previously healthy 25-year-old male patient presented with painless right hemi-mandibular swelling that had been first noticed 4 months earlier. Physical examination showed a palpable mass along the right ramus of the mandible. Panoramic radiography revealed a lobulated intraosseous lesion in the right hemi-mandible, and the

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lesion was predominantly sclerotic and had a peripheral lytic component. The lesion involved the roots of the second premolar and first molar and abutted the mandibular canal (Figure 1). Computed tomography (CT), magnetic resonance imaging (MRI), and 18F-FDG PET/CT were then performed.

The CT scan showed a mixed sclerotic and lytic destructive lesion in the body of the right hemi-mandible. It had measurements of 2.0 × 2.2 cm and was surrounded by reactive bone sclerosis (Figure 2). On MRI, the lesion appeared expansile and was associated with destruction of the outer mandibular cortex with extraosseous submucosal extension. The lesion showed low signal intensity on T1-weighted sequence (Figure 3A) and predominantly high signal intensity on short tau inversion recovery (Figure 3B). Following administration of intravenous gadolinium contrast, the lesion revealed strong enhancement (Figure 3C). Whole-body 18F-FDG PET/CT imaging showed significantly increased fluorodeoxyglucose (FDG) uptake with maximum standardized uptake value (SUV_{max}) value of 5.5, corresponding to the lytic lesion in the body of the right hemi-mandible, as noted in Figure 4. No other FDG-avid disease uptake in the remainder of the body was present.

The patient underwent open excisional biopsy. Histologic examination showed randomly interconnecting osteoid and calcified irregular bone trabeculae surrounded by large plump osteoblasts with abundant eosinophilic cytoplasm and eccentric vesicular nuclei, many of which contained prominent nucleoli (Figure 5). These epithelioid osteoblasts were focally arranged in cords and solid sheets around osteoid (Figure 6) and were surrounded by heavily calcified bone trabeculae (Figure 7). These features helped establish a diagnosis of epithelioid osteoblastoma.

The patient subsequently underwent right partial mandibulectomy and titanium plate reconstruction. No recurrence was noted at the 1-year follow-up examination.

Fig. 1. Panoramic radiography revealed a small lobulated intraosseous lesion in the right hemi-mandible that was predominantly sclerotic with a peripheral lytic component. The lesion involved the roots of the second premolar and first molar and abutted the mandibular canal but spared the inferior border of the mandible.

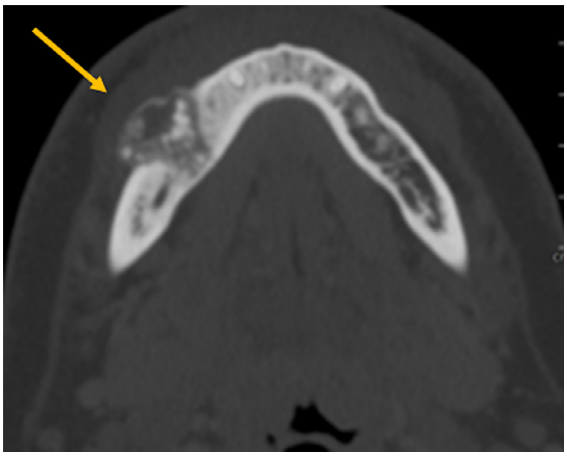

Fig. 2. Axial computed tomography (CT) bone window section revealed a mixed sclerotic and lytic destructive lesion in the body of the right hemi-mandible. Surrounding reactive bone sclerosis was also present.

DISCUSSION

Epithelioid osteoblastoma exhibits locally aggressive behavior and a tendency to recur but does not have the propensity to metastasize. Unlike the lesion in the case described in this report, it typically grows to a size larger than 4 cm, in contrast to conventional osteoblastoma, which rarely exceeds 4 cm.[13] Varshney et al. suggested that epithelioid osteoblastoma lies on a continuum between benign conventional osteoblastoma and low-grade malignant osteosarcoma because it exhibits histologic findings and clinical behavior that may be suggestive of both entities.[14] This has caused confusion among pathologists and clinicians in establishing the diagnosis, which is particularly important because these entities differ in their recommended treatment and prognosis. Thus, it is necessary to closely correlate clinical, radiologic, and histologic findings before making the diagnosis of epithelioid osteoblastoma.

To the best of our knowledge, epithelioid osteoblastoma of the mandible has been reported in only 7 cases in the English literature. Unlike conventional osteoblastoma, it appears to favor the mandible in 35% of cases and the maxilla in 19% in a review by Filippi, et al.[13,15-20] It has also been described in the skull, thyroid cartilage, clavicle, soft tissue of the axilla, vertebrae, skin, long bones, calcaneus, and toe.[14,15,21-28] The most common initial presentation is pain, which is described as dull and localized in nature, although this finding is not necessarily universal because it was not present in the patient previously described. Alkaline phosphatase (ALP) values have been found to be significantly more elevated in epithelioid osteoblastoma than in conventional osteoblastoma, with ALP values greater than 225 μ/L found in 70% of the patients with the epithelioid subtype.[28]

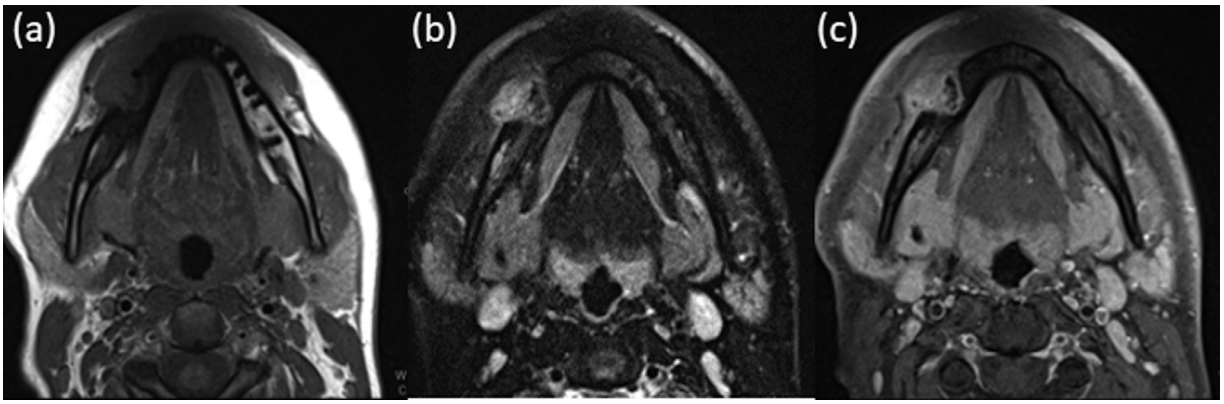

Fig. 3. Axial T1-weighted image **(A)**, axial signal intensity on short tau inversion recovery (STIR) **(B)**, and axial T1 fat saturation image with gadolinium **(C)** show the eccentric expansile lesion arising from right hemi-mandibular body with destruction of the outer mandibular cortex and extraosseous submucosal extension. The lesion exhibited low intensity on T1-weighted sequence, predominantly high signal intensity on STIR, and strong enhancement on injection of gadolinium contrast.

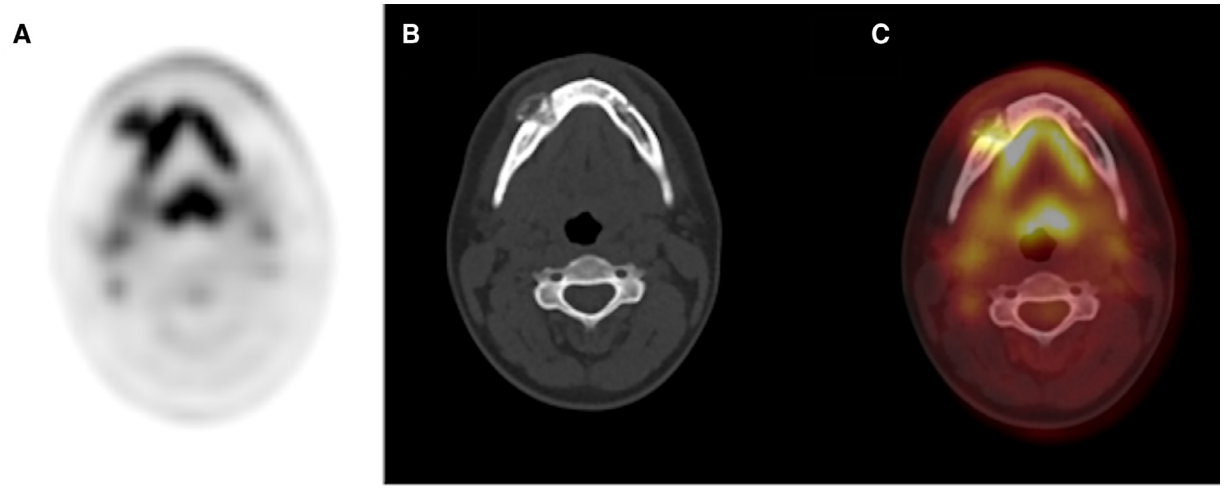

Fig. 4. Axial positron emission tomography (PET) **(A)**, computed tomography (CT) **(B)**, and fused PET/CT **(C)** images show the hypermetabolic expansile lytic bone lesion in the body of the right hemi-mandible.

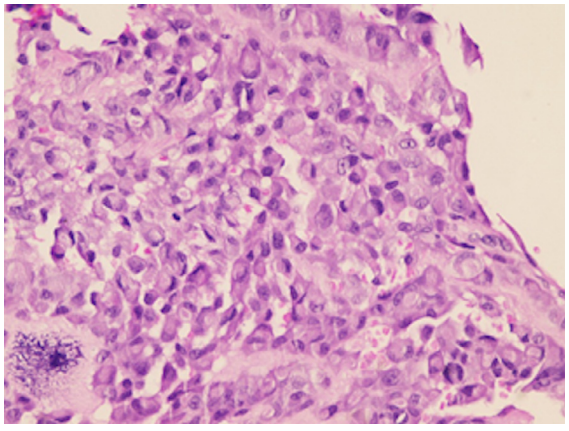

Fig. 5. Histologic section reveals solid sheets of atypical epithelioid osteoblasts, many of which show prominent nucleoli (hematoxylin and eosin; original magnification × 40).

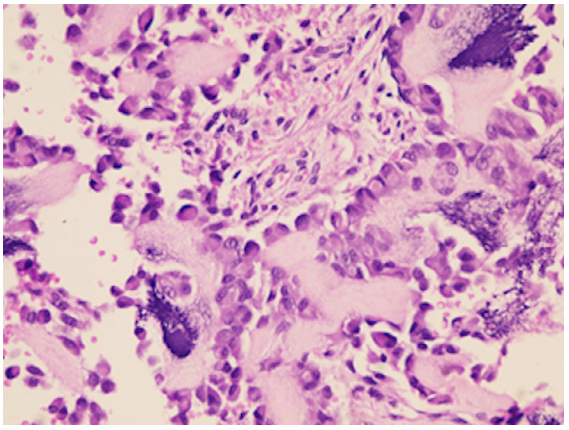

Fig. 6. Osteoid rimmed by plump epithelioid osteoblasts (hematoxylin and eosin; original magnification × 40).

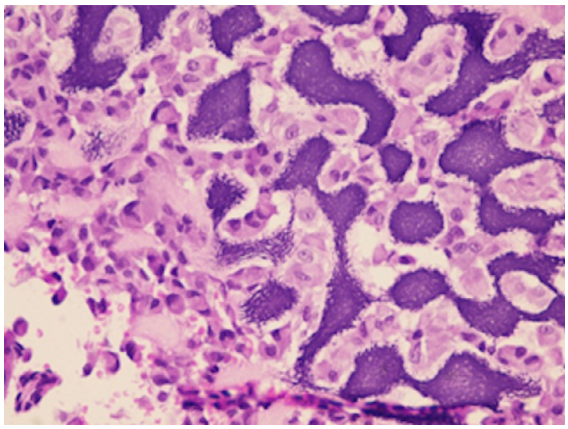

Fig. 7. Epithelioid osteoblasts surrounded by heavily calcified bone trabeculae (hematoxylin and eosin; original magnification × 40).

Positron emission tomography/computed tomography (PET/CT) is an indispensable modality in the diagnosis and staging of many cancers, and its use continues to increase. FDG, the most common radiotracer used in PET/CT, has increased uptake in cells with high glucose metabolism, such as cancer cells and some normal cells in certain organs (e.g., brain, heart). Several benign bone entities, including osteomyelitis, osteoid osteoma, and conventional osteoblastoma, exhibit increased vascularity and appear FDG avid on PET/CT. Similarly, epithelioid osteoblastoma is well vascularized, with active deposition of osteoid, and it displays findings that may mimic those of malignant bone tumors.

The SUV_{max} value of the lesion in this patient was 5.5, which, in the case of a solid organ tumor mass, would have been confidently reported as indicating malignancy. Yet, in bone, malignant and benign entities have greatly overlapping SUV_{max} values, making it difficult to differentiate between them on the basis of PET/CT findings.[29,30] Accordingly, we believe that PET/CT has a limited role in cases of confirmed epithelioid osteoblastoma. Its role comes into play to rule out distant lesions in cases where a conclusive diagnosis of epithelioid osteoblastoma cannot be obtained by histology as malignancy has not been ruled out.

The preferred treatment for epithelioid osteoblastoma is en bloc surgical resection with a wide margin and subsequent reconstruction, as appropriate. Radiation therapy is not necessary if complete excision of the lesion is performed. Postexcision recurrence of epithelioid osteoblastoma has been reported in some cases and is more likely to occur when there has been piecemeal or incomplete resection of the lesion.[31] Moreover, higher ALP values and lesion size greater than 3 cm have also been linked to increased risk of recurrence.[28]

CONCLUSIONS

We presented here a rare case of mandibular epithelioid osteoblastoma and described its radiographic features; CT, MRI, and PET/CT findings; and histologic appearance. The PET/CT features have not been described previously in the literature. PET/CT is not specific in differentiating between malignant and benign bone lesions and does not provide additional information beyond that provided by CT or MRI in cases of confirmed epithelioid osteoblastoma.

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