Primary intraosseous xanthoma of the frontal bone in a child: illustrative case

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BACKGROUND Skull lesions are a common finding in children, with dermoid cysts and eosinophilic granulomas observed most frequently. However, primary intraosseous xanthomas of the calvaria, which are lytic, expansile lesions that develop without underlying hyperlipidemic disease, are rare in children, with only one prior case reported.

OBSERVATIONS The authors describe the case of a healthy 6-year-old male who presented with a 2-month history of an enlarging midline skull mass that developed after a recent minor trauma. Imaging showed a full-thickness, lytic frontal bone lesion with an aggressive appearance and heterogeneous contrast enhancement. The patient underwent gross-total resection of the lesion with placement of a mesh cranioplasty. Histopathology revealed a primary intraosseous xanthoma. The patient was discharged on postoperative day 2 and required no further treatment at the 1-month follow-up.

LESSONS This is the first reported case of a primary intraosseous xanthoma in the frontal bone of a pediatric patient. It emphasizes the need to include primary xanthomas in the differential diagnosis for pediatric skull lesions, particularly when the lesion has an aggressive radiographic appearance or the patient has a history of focal trauma. Furthermore, our findings indicate that resection, together with subsequent monitoring for lesion recurrence, is an adequate first-line treatment.

https://thejns.org/doi/abs/10.3171/CASE23640

KEYWORDS xanthoma; skull tumor; pediatrics

Skull lesions are common in the pediatric population and are most frequently caused by dermoid cysts, eosinophilic granulomas, or skeletal dysplasia.1 Intraosseous xanthomas, benign expansile lesions characterized histologically by abundant lipid-laden histiocytes, are another possible cause of a calvarial mass, but they almost never occur in children.2,3 Furthermore, when intraosseous xanthomas are observed in children, these lesions generally impact the appendicular skeleton4 and arise almost exclusively in the setting of hyperlipidemic disease or another systemic condition that may alter fat metabolism (e.g., diabetes).2,5–11 This type of lesion in the absence of systemic disease, termed a “primary intraosseous xanthoma,” is exceptionally rare, especially in the pediatric population.2,5–10,12 Although intraosseous xanthomas have been noted to affect the frontal and temporal bones, the orbit, and the mandible of adults,2,5–11,13 there has been only one reported case of a calvarial xanthoma in a child.1

In this report, we describe the case of a healthy 6-year-old male, with no history of hyperlipidemia or other systemic disease, who presented with an enlarging mass on the anterior skull after a minor head trauma. The patient underwent resection of the lesion, and a pathological diagnosis of primary intraosseous xanthoma was made.

Illustrative Case

A 6-year-old male with no past medical history presented with an enlarging midline mass lesion on his anterior head. The lesion had developed over 2 months and was first noted after a minor head injury. The patient was asymptomatic, denying any headache

ABBREVIATIONS CT = computed tomography; MRI = magnetic resonance imaging.

INCLUDE WHEN CITING Published May 13, 2024; DOI: 10.3171/CASE23640.

SUBMITTED November 5, 2023. ACCEPTED February 29, 2024.

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or new neurological phenomena. On physical examination, he was neurologically intact, and the lesion was soft and nontender to palpation. In addition, the overlying skin was intact without erythema or drainage. Computed tomography (CT) scanning of the head revealed a full-thickness, 3 × 3 cm isodense lesion located within the frontal bone (Fig. 1). T1-weighted magnetic resonance imaging (MRI) demonstrated the same 3 × 3 cm mass with a heterogeneous appearance and heterogeneous contrast enhancement (Fig. 2A–C). T2-weighted MRI similarly showed distinct areas of hypo- and hyperintensity within the lesion as well as possible dural displacement without superior sagittal sinus involvement. All laboratory tests, including the patient’s lipid panel, were within normal limits.

The patient was taken to the operating room for resection. During exposure, it was noted that the lesion appeared to invade the outermost layer of dura. The lesion, including the impacted dura, was completely excised, and the surrounding bone was drilled away until healthy bone was encountered. The cranial defect was repaired with titanium mesh. Tissue from the lesion was sent for histopathological analysis, which demonstrated findings characteristic of an intraosseous xanthoma (e.g., abundant foam cells, multinucleated giant cells). Postoperative MRI was also performed immediately after surgery and showed gross-total resection, as well as an intact cranioplasty and superior sagittal sinus (Fig. 3).

The remainder of the patient’s hospital course was uncomplicated, with no postoperative concerns and well-controlled pain. He was discharged home on postoperative day 2 with instructions to follow-up in 1 month. At the follow-up, the patient reported no new symptoms. Physical examination at that time revealed no neurological deficits and an intact incision.

Patient Informed Consent

The necessary patient informed consent was obtained in this study.

Discussion

Observations

We reported on the first primary intraosseous xanthoma of the frontal bone in a pediatric patient, which had developed over months after an initial traumatic event. The patient was asymptomatic and fully recovered following gross-total resection, with no known recurrence to date. In the literature, only one other pediatric patient has been diagnosed with a calvarial intraosseous xanthoma. The patient, a 9-year-old male, was similarly asymptomatic and only presented in the setting of a bump on the right upper occipital region of his skull.1 This patient was treated via subtotal surgical curettage, with no progression of the disease at the 1-year follow-up.1 Interestingly, although the patient had no history of a hyperlipidemic disorder, and thus was also given the diagnosis of a primary calvarial xanthoma, he had Hodgkin lymphoma at the time of diagnosis.1 Although it is unclear if the patient was actively undergoing treatment for his malignancy at this time, it is important to note certain chemotherapy agents have been associated with an increased

![FIG. 1. Axial (A), sagittal (B), and bone-window axial (C) CT images obtained at presentation, revealing a 3 × 3 cm isodense lesion involving the full thickness of the skull, with possible involvement of the dura.](image1)

![FIG. 2. Axial (A), sagittal (B), and coronal (C) contrast T1-weighted MRI performed at presentation, displaying a heterogeneously enhancing 3 × 3 cm mass. Of note, images also demonstrate displacement of the underlying dura; however, the nearby superior sagittal sinus appears patent.](image2)
such as diplopia, vertigo, and an unsteady gait to otalgia, tinnitus, have reported symptoms ranging from specific cranial nerve palsies such as diplopia, vertigo, and an unsteady gait to otalgia, tinnitus, and hearing loss when the mastoid and inner ear are involved. However, it is unknown how much of an insult is required to cause xanthoma formation, and other young, healthy patients have developed such lesions with no recollected history of trauma or infection. The vast majority of patients with an intraosseous xanthoma are asymptomatic, and most lesions are nontender to palpation. When symptoms are present, they are unsurprisingly dependent on the location of the lesion and are likely caused by either mass effect or abnormal lipid accumulation in the bone. However, it is unknown how much of an insult is required to cause xanthoma formation, and other young, healthy patients have developed such lesions with no recollected history of trauma or infection.

Lessons
Primary intraosseous xanthomas are exceedingly rare, with fewer than 50 cases documented in the literature since the lesion was first characterized in the 1980s. Although the pathogenesis of a secondary intraosseous xanthoma is fairly well understood, being attributed to elevated cholesterol levels that then abnormally deposit into bone, the mechanism underlying a primary lesion is more obscure. As was the case in our normo-lipidemic patient, it is believed that local trauma or infection may play a key role in primary intraosseous xanthoma development. The hypothesized underlying mechanism is a robust local inflammatory response due to trauma or infection, leading to an increase in vascular permeability and abnormal lipid accumulation in the bone. However, it is unknown how much of an insult is required to cause xanthoma formation, and other young, healthy patients have developed such lesions with no recollected history of trauma or infection.

The radiographic appearance of intraosseous xanthomas is similar between children and adults. In the craniofacial region, the typical findings on a radiograph are a well-defined lytic lesion surrounded by a sclerotic margin. Less commonly, however, bone xanthomas can appear more aggressive with an irregular shape, ill-defined borders, or punched-out margins. CT images generally show an isodense or heterogeneous contrast enhancement. MRI can vary but most commonly reveals a lesion with areas of hypo- and hyperintensity on both T1- and T2-weighted imaging and heterogeneous contrast enhancement. In cases that involve the calvaria, careful attention on MRI should be given to the underlying dura and nearby sinuses to rule out possible invasion. Although imaging is an important step in lesion characterization, radiographic diagnosis of an intraosseous xanthoma is near impossible given the variability in findings and their often indistinguishable appearance from other lesions. Other similarly appearing masses include lytic boney metastases (e.g., clear cell carcinoma), primary malignant bone tumors, nonossifying fibromas, benign fibrous histiocytoma, extranodal Erdheim-Chester disease, Rosai-Dorfman disease, and xanthogranulomatous osteomyelitis. Although some of these diseases are less likely to be observed in pediatric patients (e.g., metastatic cancer), which can aid in diagnostic probability, all options should remain on the differential until a pathological diagnosis can be made.

Given the lack of discernible clinical or radiographic findings, histopathological assessment is required for a correct diagnosis of an intraosseous xanthoma. Histologically, primary intraosseous xanthomas are characterized by macrophage-like mononuclear cells; foam cells with a granular, eosinophilic cytoplasm; multinucleated giant cells; and varying degrees of intertwined fibrous tissue. More specifically, positive CD68 and negative CD1a and S-100 staining is considered a hallmark for diagnosis, as it indicates the presence of abundant foam cells and simultaneously rules out Langerhan’s histiocytosis. Unlike other lesions on the differential, such as benign fibrous histiocytoma, which intraosseous xanthomas were long thought to be subset of, spindle cells are not a prominent feature of these lesions.

For primary intraosseous xanthomas, excision or curettage is the gold-standard treatment for both children and adults, with no adjunctive therapies required. Although total resection is preferred, patients have equivocal outcomes with subtotal resections as well, with no reported cases of disease recurrence or progression in those who have undergone complete or partial removal of the lesion. Thus, although surgeons should strive for gross-total resection, it is not needed to achieve the desired outcome, and clinical judgement should be used in situations where further resection may compromise patient safety or quality of life. Furthermore, it is important to emphasize the need for a rigorous pathological diagnosis, as improper classification of these lesions can lead to overtreatment or undertreatment of the patient’s condition. For instance, for similar lesions such as Langerhan’s histiocytosis, Rosai-Dorfman disease,
and Erdheim-Chester disease, surgery may or may not be recommended alongside a mixture of systemic steroids, chemotherapy, immunotherapy, or radiotherapy. On the other hand, for lesions such as a benign fibrous histiocytoma, observation may be all that is required.

Although primary intraosseous xanthomas are rare and typically do not involve pediatric patients or the calvaria, this report adds to the literature and emphasizes that the diagnosis must be considered when clinically indicated. Although diagnosis can be suggested by clinical or radiographic features, histopathological analysis is needed for definitive characterization and subsequent treatment planning. For patients with a confirmed primary xanthoma, total excision is recommended to eliminate the disease, although subtotal resection has had similar results according to the literature.

References


Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Kundishora, Reeves, Yang, Tucker. Acquisition of data: Reyes, Wong. Analysis and interpretation of data: Madsen, Coyle, Wong, Yang. Drafting the article: Kundishora. Madsen, Reeves, Coyle, Wong, Tucker. Critically revising the article: Madsen, Reeves, Yang. Drafting the article: Kundishora, Madsen, Reeves, Coyle, Wong, Yang. Correspondence

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