

# Epithelioid hemangioma of bone: radiologic and magnetic resonance imaging characteristics with histopathological correlation

Kathleen Schenker<sup>1</sup> · Steven Blumer<sup>1</sup> · Diego Jaramillo<sup>2</sup> · Amanda L. Treece<sup>3</sup> · Aashim Bhatia<sup>4</sup> 

Received: 30 January 2017 / Revised: 10 May 2017 / Accepted: 6 June 2017 / Published online: 18 July 2017  
© Springer-Verlag GmbH Germany 2017

## Abstract

**Background** Epithelioid hemangioma is a rare vascular tumor that can occur in soft tissues or bone. The tumor is part of a spectrum of vascular tumors that also includes epithelioid hemangioendothelioma and angiosarcoma. When involving the bone, the tumor usually involves the metaphysis or diaphysis of the long tubular bones and most commonly occurs in adults. It has been rarely reported in pediatric patients, and in these reported patients, the tumor primarily involves the epiphysis.

**Objective** To review three cases of epithelioid hemangioma of bone occurring in pediatric patients involving the epiphysis and to explore the imaging features of this tumor.

**Materials and methods** Retrospectively review three cases of epithelioid hemangioma occurring in skeletally immature patients.

**Results** These tumors primarily involved the epiphyses or epiphyseal equivalent bones. One lesion was centered in the metaphysis but extended to the epiphysis. These are three cases presenting in an unusual location and at an unusual age.

**Conclusion** Epithelioid hemangioma, though rare, can occur in pediatric patients and appears to involve the epiphyses in these patients. This is in contrast to the usual age and location reported. Epithelioid hemangioma may be considered for an epiphyseal lesion in a skeletally immature patient.

**Keywords** Adolescent · Bone · Epiphysis · Epithelioid hemangioma · Magnetic resonance imaging · Radiography

## Introduction

Epithelioid vascular tumors of the bone are rare, representing an overlapping spectrum of tumors ranging from low to high malignant potential. These include epithelioid hemangioma, epithelioid hemangioendothelioma and angiosarcoma. Epithelioid hemangioma is most commonly found in soft tissues. Bone is the second most common location for this tumor [1]. When occurring in bone, the metaphysis or diaphysis of long tubular bones is most commonly affected [1, 2]. Solitary lesions are the most common. However, multicentric disease has been reported in 18–25% of cases, most commonly involving the same bone or same extremity [1, 3]. Most cases occur between the third and sixth decade of life [2].

Reported cases of epithelioid hemangioma span a wide age range and affect multiple regions of the body. Here we review three cases of pathology-proven epithelioid hemangioma in the pediatric population. All patients had lesions that involved the epiphysis or epiphyseal equivalent. These cases presented in an unusual age group and occurred in an unusual location. We discuss the imaging features of these three cases of epithelioid hemangioma and compare them to the typical imaging features of other epiphyseal lesions. While definitive diagnosis based on imaging features alone is not possible and histological evaluation is required for definitive diagnosis,

✉ Aashim Bhatia  
Aashimbhatia@gmail.com

<sup>1</sup> Department of Radiology,  
Nemours/Alfred I. duPont Hospital for Children,  
Wilmington, DE, USA

<sup>2</sup> Department of Radiology, Nicklaus Children's Hospital,  
Miami, FL, USA

<sup>3</sup> Departments of Pathology and Laboratory Medicine,  
Children's Hospital Colorado,  
University of Colorado School of Medicine,  
Aurora, CO, USA

<sup>4</sup> Department of Radiology,  
Monroe Carell Jr. Children's Hospital at Vanderbilt,  
2200 Children's Way, Suite 1422, Nashville, TN 37232, USA

certain imaging features may suggest the diagnosis of a vascular tumor over the more common epiphyseal lesions, mainly chondroblastoma.

## Materials and methods

Three patients with epithelioid hemangioma of the bone, confirmed by surgical pathology, were identified at two different institutions between 2012 and 2014. We retrospectively reviewed the clinical presentation, imaging features and treatment for each patient. All patients had imaging performed at an outside facility. All patients initially had radiographs. Two patients subsequently had a non-contrast magnetic resonance imaging (MRI) and one patient had a contrast-enhanced MRI. Specific MRI parameters were not available as the images for each of the three patients were performed at outside facilities. Institutional Review Board approval was not required for this study as the number of cases was less than the criterion for IRB review at the originating institution.

## Results

Summary results of three patients ages 14–16 with epithelioid hemangioma of the bone confirmed by surgical pathology are found in Table 1.

**Table 1** Summary results of three patients with epithelioid hemangioma

	Case 1	Case 2	Case 3
Age	15	16	14
Gender	Male	Female	Male
Clinical presentation	Pain	Pain	Pain
Solitary/multifocal	Solitary	Solitary	Multifocal
Location	Proximal humerus epiphysis	Calcaneus	(1) Distal femoral epiphysis (2) Patella (3) Proximal fibula metaphysis
Radiologic studies	Radiograph, MRI	Radiograph, MRI	Radiograph, MRI
Radiograph			
Lesion density	Lucent	Lucent	Lucent
Margins	Sclerotic	Sclerotic	Partially sclerotic
Periosteal reaction	–	–	–
MRI signal			
T1-weighted	Iso/Slightly hyper	Iso/Slightly hyper	Iso/Slightly hyper
T2-weighted	High	High	High
Enhancement	N/A	N/A	Homogeneous
Marrow edema	+	+	+
Lymphadenopathy	No	No	No
Treatment	Curettage, resection	Curettage	Curettage

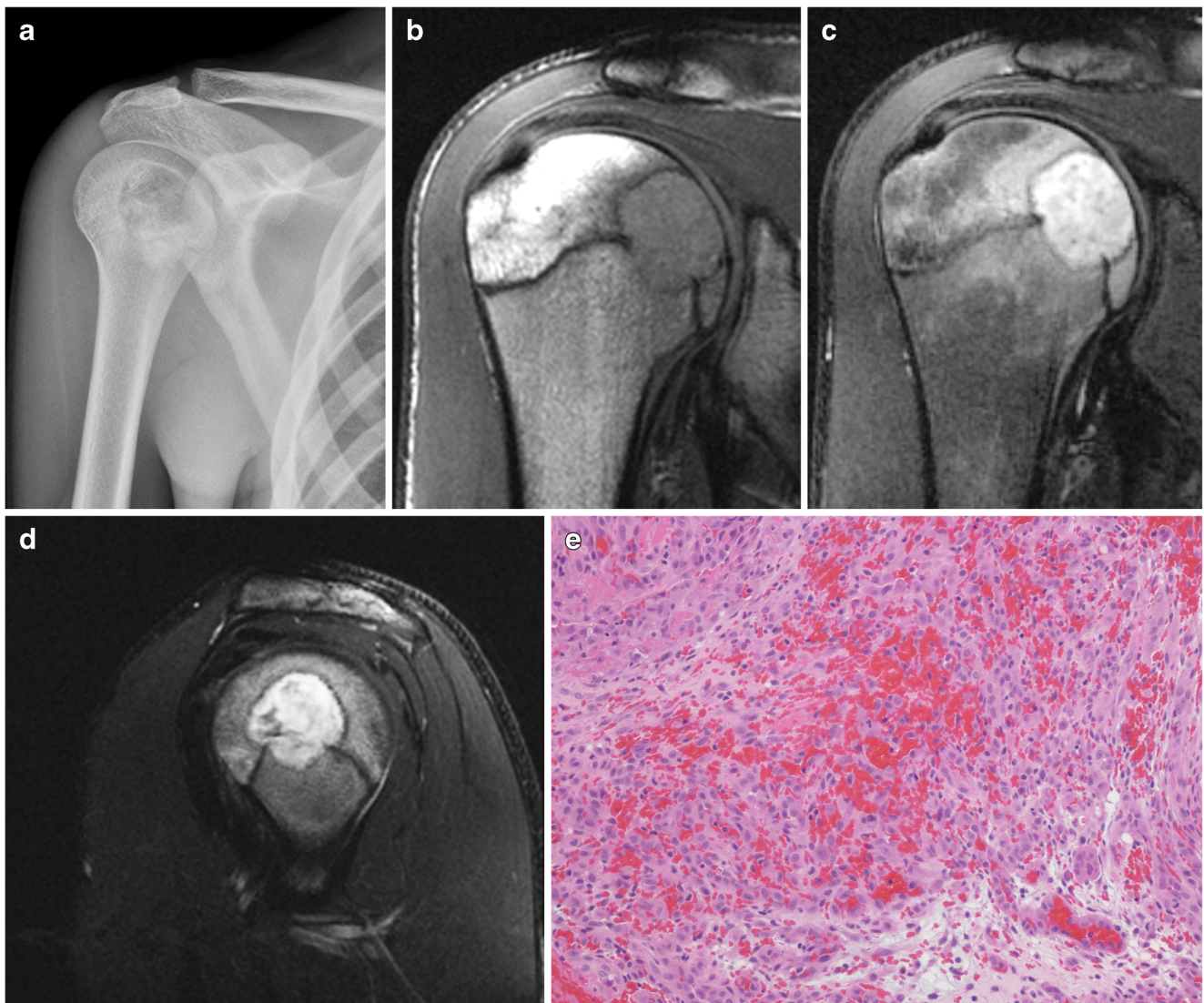
N/A not applicable

## Case 1

A 15-year-old boy presented with right shoulder pain with focal tenderness over the anterior humerus. Radiographs of the right shoulder demonstrated a well-defined lucent lesion in the humeral epiphysis with surrounding sclerosis (Fig. 1). Non-contrast MRI demonstrated a well-defined lesion that is isointense/slightly hyperintense to skeletal muscle on T1-weighted and predominately hyperintense on T2-weighted sequences. A small portion of the lower margin of the lesion extended across the humeral physis. The patient underwent open biopsy and curettage with bone grafting. However, the boy had recurrent pain and a subsequent MRI demonstrated local disease recurrence. He subsequently underwent resection of the proximal humerus with prosthetic reconstruction.

## Case 2

A 16-year-old girl with no history of trauma or injury presented with chronic right foot pain. Physical examination revealed only mild tenderness to palpation at the medial calcaneus. Radiographs of the right foot showed a well-defined lucent lesion in the calcaneus with some surrounding sclerosis (Fig. 2). Non-contrast MRI showed the calcaneal lesion was isointense to skeletal muscle on T1-weighted sequence and hyperintense on T2-weighted sequence. There was extensive surrounding marrow edema involving most of the calcaneus and surrounding soft-tissue edema. The patient underwent



**Fig. 1** Right shoulder radiograph and MRI in a 15-year-old boy (Case 1). Radiograph of the shoulder (a) shows a well-defined lucent lesion with a narrow zone of transition and sclerotic margin. T1-weighted sequence (b) shows a lesion iso/slightly hyperintense to skeletal muscle in proximal humeral epiphysis, crossing the physis. The lesion is heterogeneously

hyperintense with a low signal intensity rim on coronal (c) and sagittal (d) T2-weighted sequences. There is surrounding marrow edema in the humeral epiphysis. A 20X hematoxylin and eosin (H&E) stain (e) shows bland-appearing spindle cells arranged in fascicles with interspersed vessels lined with plump epithelioid cells

open biopsy with curettage and bone grafting. The postoperative course was uncomplicated.

**Case 3**

A 14-year-old boy presented with left knee pain. Radiographs demonstrated a lobulated lucent lesion in the inferior patella and smaller lucent lesions in the distal femur and proximal fibula. There was an incomplete, thin rim of sclerosis (Fig. 3). MRI shows the lesions are iso/slightly hyperintense to skeletal muscle on T1-weighted sequence, hyperintense on T2-weighted sequence. All three lesions were homogeneously enhancing. There was marrow edema surrounding each of the lesions, most prominent in the patella. A core needle biopsy

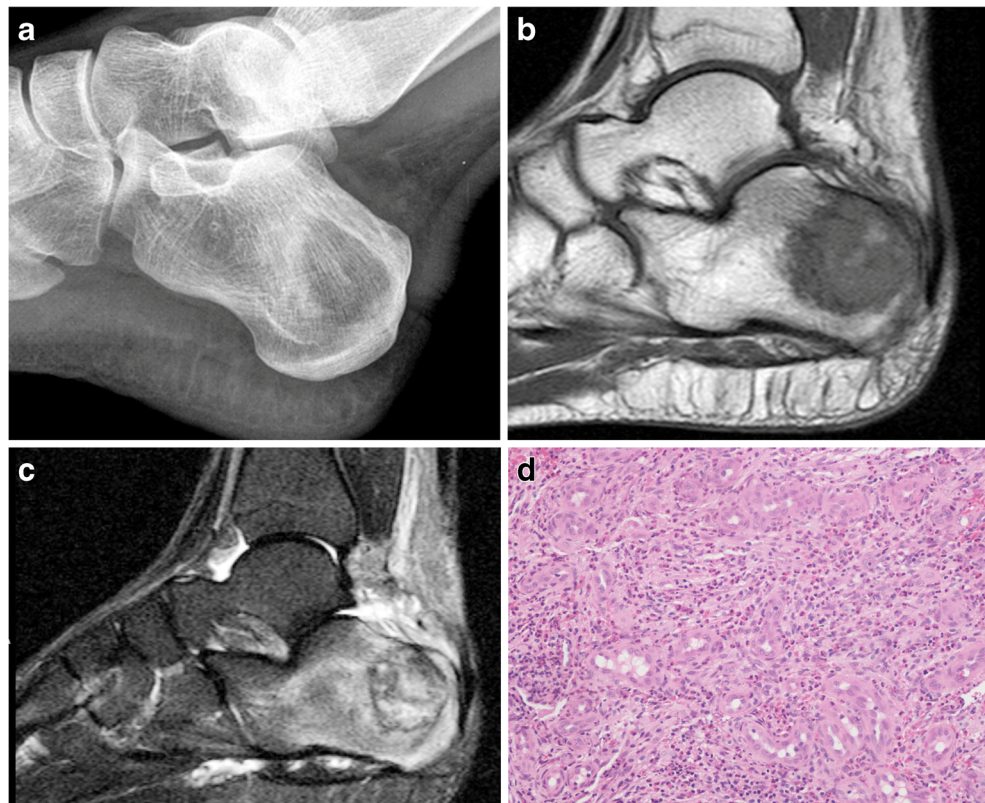
of the proximal fibular lesion revealed epithelioid hemangioma. The patient was referred and subsequently underwent curettage and grafting of all three lesions in the distal femur, patella and proximal fibula.

**Discussion**

Epithelioid hemangioma is considered a benign entity, but has the potential for lymph node involvement. Although rare, a few cases of lymph node involvement with epithelioid hemangioma have been reported in the literature [1, 4]. This phenomenon of lymph node involvement in the setting of a benign tumor has also been reported with giant cell tumors [5].



**Fig. 2** A foot radiograph and MRI in a 15-year-old girl (Case 2). Lateral foot radiograph (a) demonstrates a well-defined lucent lesion in the calcaneus with surrounding sclerosis. T1-weighted sequence (b) demonstrates a lesion isointense to skeletal muscle in the calcaneus. The lesion is heterogeneous on T2-weighted sequence (c) with a rim of low signal intensity. There is surrounding marrow and soft-tissue edema. A 20X hematoxylin and eosin (H&E) stain (d) shows bland-appearing spindle cells arranged in fascicles with interspersed vessels lined with plump epithelioid cells



The World Health Organization previously classified epithelioid vascular tumors into only two categories: benign (hemangioma and epithelioid hemangioma) and malignant (epithelioid hemangioendothelioma and angiosarcoma). However, in the most recent 2013 World Health Organization classification, epithelioid hemangioma is now classified as intermediate grade while epithelioid hemangioendothelioma and angiosarcoma are classified as malignant [6]. This recent revised classification of epithelioid hemangioma is likely due to the reported cases of recurrence and lymph node involvement [1, 4]. Importantly, there are no reported deaths from the disease, including those patients presenting with local recurrence or lymph node involvement [1, 3, 4].

Epithelioid hemangioma cannot be distinguished from epithelioid hemangioendothelioma based solely on imaging— even histological differentiation can be challenging. While epithelioid hemangioendothelioma, in general, tends to grow in a more infiltrative pattern, histological evaluation of epithelioid hemangioma will show more mature vessel formation and more lobulated growth pattern than epithelioid hemangioendothelioma [2]. Recently, the identification of a WWTR1-CAMTA1 gene fusion that is present in epithelioid hemangioendothelioma, but not in epithelioid hemangioma, has allowed definitive distinction between these overlapping entities [7]. Distinguishing epithelioid hemangioma from epithelioid hemangioendothelioma is important because more aggressive treatment is required

for epithelioid hemangioendothelioma as it has a higher propensity for multifocality and distant spread [5].

Epithelioid hemangioma of bone most commonly affects the long tubular bones but has been reported elsewhere in small tubular bones of the hands and feet, the vertebrae and flat bones [1]. Males and females are affected equally [5]. A majority of these lesions involve the metaphysis or diaphysis and tend to involve the lower extremities [1, 2]. The peak incidence occurs between 30 and 60 years of age [2]. Though rarely reported, these lesions can occur in the pediatric population and have been reported in children as young as 7 years [8].

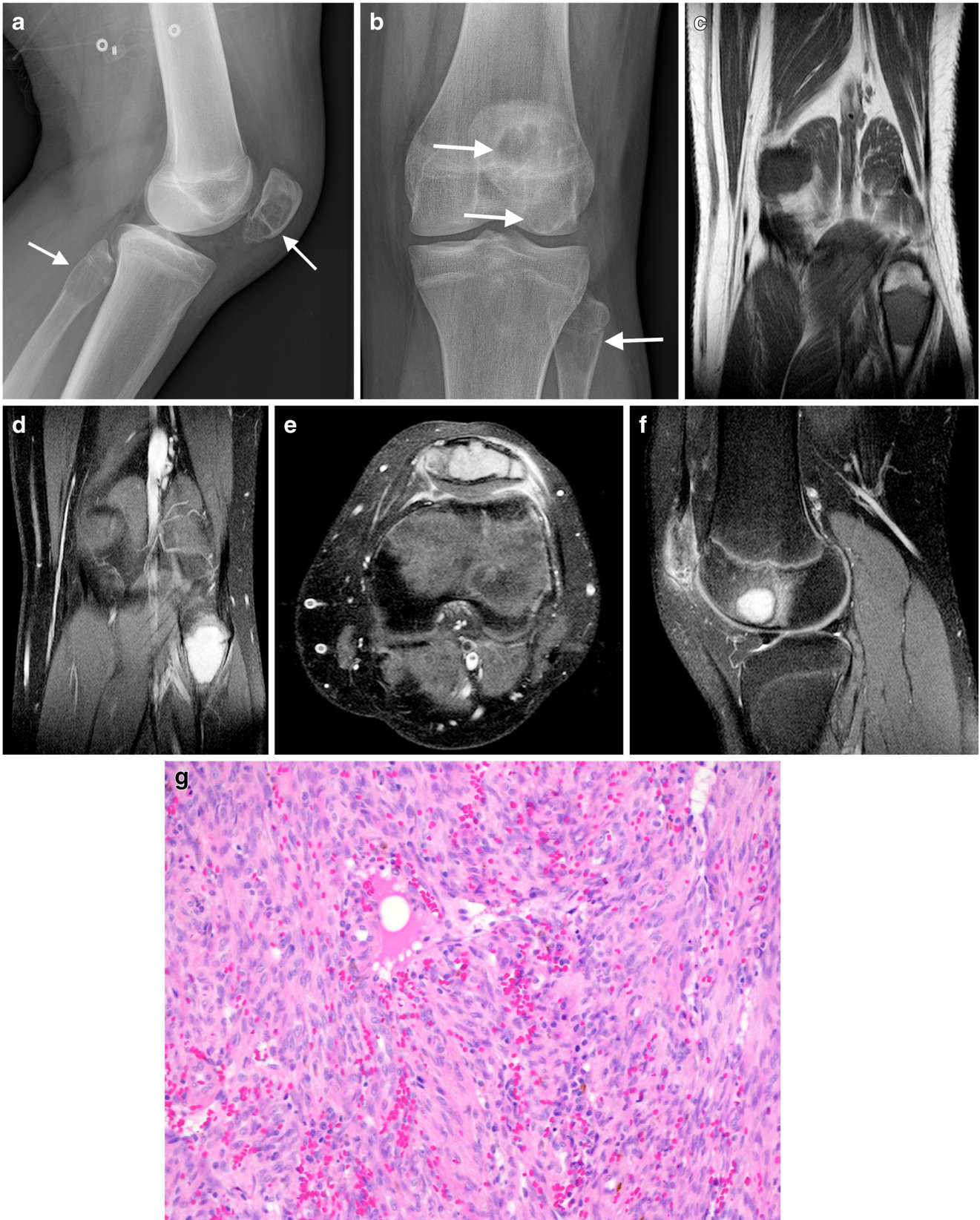
We report three cases of epithelioid hemangioma in adolescents ages 14, 15 and 16. These patients had lesions that involved

**Fig. 3** Left knee radiograph and MRI in a 14-year-old boy (Case 3). Lateral (a) and anteroposterior (b) radiographs of the left knee show well-defined lucent lesions in the patella, distal femur and proximal fibula (arrows). There is an incomplete thin rim of sclerosis. Coronal T1-weighted sequence (c) shows a iso/slightly hyperintense lesion to skeletal muscle involving the proximal fibular metaphysis and epiphysis. Coronal T1-weighted fat-suppressed post-contrast image (d) shows homogeneous, avidly enhancing lesion in the proximal fibular metaphysis. Axial T1-weighted fat-suppressed post-contrast images (e) show a homogeneously enhancing lobulated lesion in patella. Sagittal short tau inversion recovery (STIR) image (f) shows the lesion in the distal femoral epiphysis is hyperintense with mild surrounding marrow edema. A 20X hematoxylin and eosin (H&E) stain (g) shows bland-appearing spindle cells arranged in fascicles with interspersed vessels lined with plump epithelioid cells



the epiphysis or epiphyseal equivalent. In the case of multifocal involvement, one lesion was predominately centered in the

metaphysis but did also involve the epiphysis. None of these cases had lymph node involvement. Recently, a similar case of



epithelioid hemangioma occurring in the distal radial epiphysis was reported in a 17-year-old boy [9]. Together, these represent cases presenting in an uncommon age group and in an uncommon location. When occurring in the epiphysis or epiphyseal equivalent in a pediatric patient, the appearance of this vascular tumor can resemble a chondroblastoma. In cases of multifocal involvement, such as Case 3, the differential diagnoses can be expanded to include eosinophilic granuloma or metastases.

Based on these present cases and previously reported cases [8, 9], the radiographic appearance of epithelioid hemangiomas are well-defined lucent lesions with a rim of surrounding sclerosis. On MRI, they are heterogeneous but predominately T2-weighted hyperintense, similar to other vascular tumors. They are isointense or slightly hyperintense to skeletal muscle on T1-weighted sequences. There is variable surrounding marrow edema and enhancement. Only one of these cases had a contrast-enhanced MRI, which demonstrated homogeneous enhancement. Cortical disruption has been reported, but none was seen in these cases [1, 8]. While no periosteal reaction was seen in these cases, it has been reported previously in those cases where focal cortical disruption occurs [10].

Chondroblastoma and epithelioid hemangioma have overlapping imaging features, and differentiation based on imaging features alone may not be possible. Radiographically, chondroblastoma nearly always appears as a well-defined lucent lesion with a thin sclerotic rim. Calcification is common. On MRI, the signal intensity on T2-weighted sequences can vary considerably based on the amount of chondroid matrix, calcification and cystic components [11]. Surrounding marrow edema is commonly present [12]. These imaging features overlap the radiographic and MRI appearance of the cases of epithelioid hemangioma described here. Chondroblastoma may have periosteal reaction and adjacent soft-tissue reaction [12, 13]. In one study reviewing 22 cases of chondroblastoma, 18 showed periostitis and 16 had obvious soft-tissue reaction [12]. A larger study of 214 cases found that thick periostitis was common [14]. None of the cases presented here demonstrated periosteal reaction. Additionally, the presence of calcification can provide a clue to the diagnosis of chondroblastoma [12].

While rarer than chondroblastoma, chondrosarcoma may also be considered in the differential diagnosis for an epiphyseal lesion. Chondrosarcomas are rare in children, with fewer than 10% occurring in skeletally immature patients. A majority of these tumors involve the metaphysis or diaphysis, with only 15% occurring in the epiphysis. Radiographs show an expansile lucent lesion with varying degrees of “ring and arc” calcification [15]. On MRI, chondrosarcoma shows varied enhancement, with lower grade lesions demonstrating predominantly peripheral and septal enhancement [15]. The cases of epithelioid hemangioma presented here showed no bony expansion or internal calcification. However, bony expansion has been reported with epithelioid hemangioma, with many such cases involving small tubular bones [1]. While only one

of these cases had a contrast-enhanced MRI, the lesion did demonstrate homogeneous enhancement, seen in Case 3, and is consistent with previously reported literature [9].

## Conclusion

Though rare, epithelioid hemangioma of bone does occur in pediatric patients and appears to involve the epiphysis more so than in adults. This is in contrast to the typical age group and typical metaphyseal/diaphyseal location reported for these tumors. While there are no imaging features that can reliably distinguish this vascular tumor from other more common pediatric epiphyseal lesions, particularly chondroblastoma, certain imaging features discussed here can be helpful if present. Furthermore, distinguishing between types of vascular tumors, mainly epithelioid hemangioma and epithelioid hemangioendothelioma, is not possible on the basis of imaging alone. Histological evaluation is critical for distinction, as the accepted treatment for epithelioid hemangioendothelioma is more aggressive than that for epithelioid hemangioma [3].

## Compliance with ethical standards

**Conflicts of interest** None

## References

- Nielsen GP, Srivastava A, Kattapuram S et al (2009) Epithelioid hemangioma of the bone revisited: a study of 50 cases. *Am J Surg Pathol* 33:270–277
- Wenger DE, Wold LE (2000) Benign vascular lesions of bone: radiologic and pathologic features. *Skeletal Radiol* 29:63–74
- Errani C, Zhang L, Panicek DM et al (2012) Epithelioid hemangioma of bone and soft tissue: a reappraisal of a controversial entity. *Clin Orthop Relat Res* 470:1498–1506
- Floris G, Deraedt K, Samson I et al (2006) Epithelioid hemangioma of bone: a potentially metastasizing tumor? *Int J Surg Pathol* 14:9–15
- Errani C, Vanel D, Gambarotti M et al (2012) Vascular bone tumors: a proposal of a classification based on clinicopathological, radiographic and genetic features. *Skeletal Radiol* 41:1495–1507
- Jo VY, Fletcher CD (2014) WHO classification of soft tissue tumours: an update based on the 2013 (4<sup>th</sup>) edition. *Pathology* 46:95–104
- Errani C, Zhang L, Sung YS et al (2011) A novel WWTR1-CAMTA1 gene fusion is a consistent abnormality in epithelioid hemangioendothelioma of different anatomic sites. *Genes Chromosomes Cancer* 50:644–653
- Sung MS, Kim YS, Resnick D (2000) Epithelioid hemangioma of bone. *Skeletal Radiol* 29:530–534
- Bregman JA, Jordanov MI (2014) Epithelioid hemangioma occurring in the radial styloid of a 17-year-old boy—an unusual presentation of an uncommon neoplasm. *Clin Imaging* 38:899–902
- Ling S, Rafii M, Klein M (2001) Epithelioid hemangioma of bone. *Skeletal Radiol* 30:226–229
- Jee WH, Park YK, McCauley TR et al (1999) Chondroblastoma: MR characteristics with pathologic correlation. *J Comput Assist Tomogr* 23:721–726

12. Weatherall PT, Maale GE, Mendelsohn DB et al (1994) Chondroblastoma: classic and confusing appearance at MR imaging. *Radiology* 190:467–474
13. Kaim AH, Hugli R, Bonel H, Jundt G (2002) Chondroblastoma and clear cell chondrosarcoma: radiological and MRI characteristics with histopathological correlation. *Skeletal Radiol* 31:88–95
14. Brower AC, Moser RP, Kransdorf MJ (1990) The frequency and diagnostic significance of periostitis in chondroblastoma. *AJR Am J Roentgenol* 154:309–314
15. Mosier SM, Patel T, Strenge K, Mosier AD (2012) Chondrosarcoma in childhood: the radiologic and clinical conundrum. *J Radiol Case Rep* 6:32–42