

## Imaging aspects of Camurati-Engelmann disease

SIMONE UEZATO<sup>1\*</sup>, GUSTAVO DIAS<sup>2</sup>, JULIANA INADA<sup>3</sup>, MARCELO VALENTE<sup>4</sup>, ELOY FERNANDES<sup>5</sup>

<sup>1</sup>Resident Physician at Hospital Estadual Vila Alpina/Diagnostic Imaging Service II, associated with the Luiz Roberto Barata Barradas Specialist Medical Outpatient Clinic (AME), São Paulo, SP, Brazil

<sup>2</sup>Resident Physician at Hospital A.C.Camargo Cancer Center, São Paulo, SP, Brazil

<sup>3</sup>Orthopedist, Prefeitura Municipal de Barueri, Barueri, SP, Brazil

<sup>4</sup>Supervising Physician at the Continuing Education/Medical Residency in Radiology and Imaging Diagnosis, Hospital Estadual Vila Alpina, São Paulo, SP, Brazil

<sup>5</sup>Affiliate Professor of the Department of Imaging Diagnosis, Universidade Federal de São Paulo. Radiologist, Diagnostic Imaging Service II, associated with the Luiz Roberto Barradas Barata Specialist Medical Outpatient Clinic (AME), São Paulo, SP, Brazil

Study conducted at Hospital Estadual Vila Alpina/Diagnostic Imaging Service II, São Paulo, SP, Brazil

Article received: 1/20/2016

Accepted for publication: 1/30/2016

**\*Correspondence:**

Address: Av. Almirante Delamare, 1534  
São Paulo, SP – Brazil  
Postal code: 04230-000  
simouez@yahoo.com.br

<http://dx.doi.org/10.1590/1806-9282.62.09.825>

### CASE REPORT

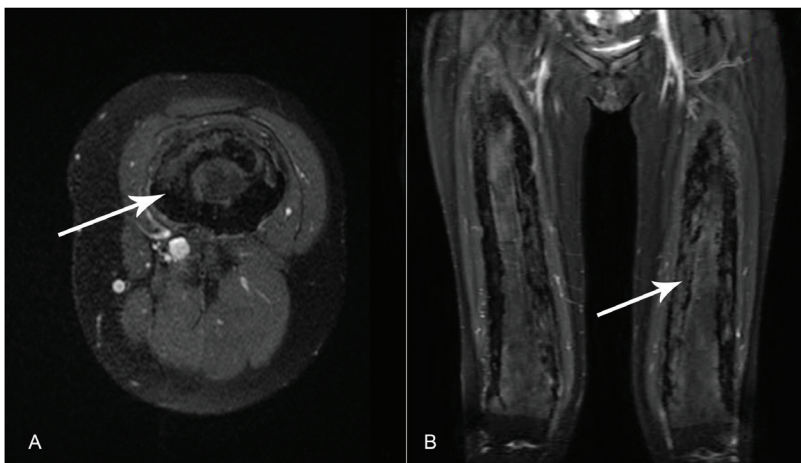
A 35-year-old female patient undergoing outpatient monitoring at the Specialist Medical Outpatient Clinic (AME, in portuguese acronym) in Mogi Guaçu, São Paulo, Brazil.

Since childhood the patient has presented generalized pain in the body, mainly in the lower limbs, which has been more intense for the last 2 years, with no relation to physical effort, and which gets worse with changes in ambient temperature. Generalized weakness, reduced muscle strength and discreetly staggering gait have also been reported, as well the use of hearing aids. Faced with these symptoms, the patient sought successive health services, where she only received symptomatic treatment. Due to the persistence of the complaint, she underwent an X-ray of the lower limbs.

Based on the radiographic changes found, bone scintigraphy and magnetic resonance imaging (MRI) examinations were requested. There are no known cases in the family.

### RESULTS

The MRI revealed exuberant diffuse cortical thickening in the bone diaphyses, increased diameter of both femurs, intramedullary and peripheral femoral hyperintensity focal areas in the T2 weighted sequences, with enhancement after infusion of the intravenous contrast medium, which may correspond to areas of edema or inflammatory activity. The contracting mass of the muscle and subcutaneous plane had a preserved signal (Figure 1).



**FIGURE 1** A. T1-weighted fat-suppressed cross-section of the left thigh after the intravenous injection of paramagnetic contrast agent. Note the thickening and heterogeneity of the femoral cortex (arrow). The adjacent muscles and subcutaneous tissue are preserved. B. T2-weighted fat-suppressed coronal section of the thighs showing increased diameter of both femurs with irregular thickening of the cortical bone, diffuse central and medullary edema (arrow).

The X-ray of upper limbs, lower limbs and skull also showed diffuse cortical thickening, notably in the bone diaphyses and flat bones, while the bone scintigraphy revealed diffuse increase in osteogenic activity at these sites.

## DISCUSSION

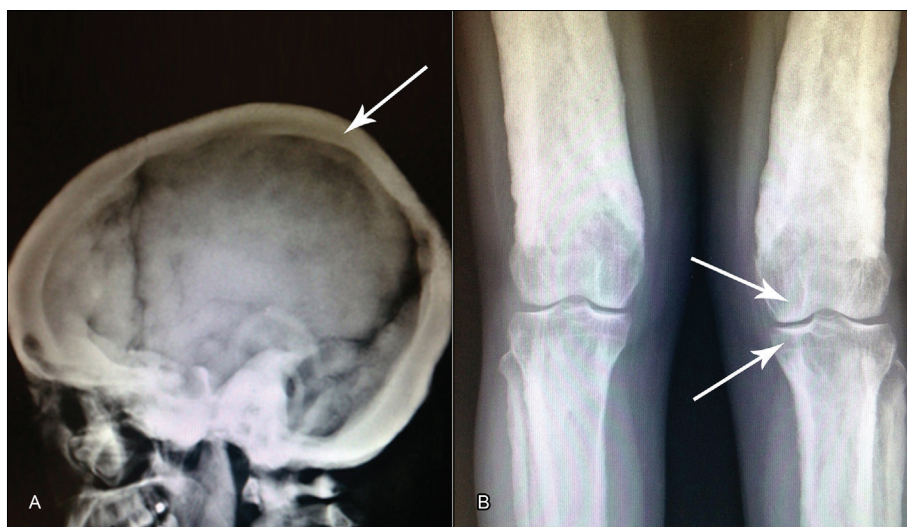
It is noteworthy that the involvement of the femurs occurs mainly in the cortical region, restricting diagnostic hypotheses to basically hereditary sclerosing bone dysplasias, particularly those resulting from defects in intramembranous ossification.<sup>2,3</sup> Intramembranous ossification occurs in the cortex of tubular bones (such as femurs) and the flat bones of the skullcap, the upper facial bones, tympanic temporal bones, vomer and medial pterygoid plate.<sup>4</sup> The hereditary disorders related to this type of ossification are: generalized cortical hyperostosis (van Buchem's disease and variants), hereditary multiple diaphyseal sclerosis (Ribbing disease) and progressive diaphyseal dysplasia (Camurati-Engelmann's disease).<sup>4</sup> Although Erdheim-Chester disease is considered part of an acquired (and not inherited) syndrome that simulates sclerosing bone dysplasia,<sup>4</sup> it is also part of the differential diagnosis.<sup>3</sup> Eventually, the possibility of osteopetrosis could be suggested; however, this disorder derives from an endochondral ossification defect (which gives rise to bone marrow)<sup>4</sup> and is therefore an ossification condition of the medullary and not the cortical region.

According to the phenotypic presentation, some of these pathologies can be excluded. In generalized cortical hyperostosis (van Buchem's disease and variants),<sup>4</sup> facial abnormalities occur, such as flattened forehead, elongated jaw and

syndactyly of the second and third fingers. Meanwhile, in hereditary multiple diaphyseal sclerosis (Ribbing disease)<sup>4</sup> there is unilateral or bilateral asymmetric/asynchronous involvement of the long bones, typically the tibia and femur,<sup>4</sup> as well as non-involvement of skullcap.<sup>4</sup> Since the patient in this study has atypical fascicles, bilateral and symmetrical bone involvement and cortical thickening in the skull radiography, other diagnostic possibilities would be more likely. These characteristics<sup>4</sup> are seen both in Erdheim-Chester disease (non-Langerhans cell histiocytosis), and in progressive diaphyseal dysplasia (Camurati-Engelmann disease). However, the extra-osseous manifestations of Erdheim-Chester disease (diabetes insipidus, painless bilateral exophthalmos, chronic renal failure, hydronephrosis, pulmonary fibrosis, and heart failure) and associated bone infarcts<sup>4</sup> were not found, as the only comorbidity presented by the patient was dysacusis.

Dysacusis, in turn, is described as one of the symptoms of progressive diaphyseal dysplasia (Camurati-Engelmann disease). Bone involvement in this disease begins in the tibial and femoral diaphyses,<sup>3,5</sup> in a bilateral and symmetrical manner<sup>1,6</sup> progressing to the other long bones with progressive bone deformity. In descending order of frequency, it affects the tibia, femur, fibula, humerus, ulna and radius<sup>3,5</sup> and, more rarely, the middle segment of the clavicles.<sup>4,7</sup> In severe cases, isolated sclerosis in the posterior region of the vertebral body can also be observed.<sup>3,4</sup>

The metaphysis and epiphysis are typically not involved, as these regions are formed by endochondral ossification<sup>4</sup> (Figure 2), although during disease progression they may become involved secondarily.<sup>5</sup>



**FIGURE 2** A. Radiography of skull in profile. Note the diffuse cortical thickening of the skull cap (arrow). B. Radiography of the knees in anteroposterior view. Preservation of the cortical thickness of the epiphyses of the femurs, tibias and fibulae (arrows) is observed.

In rare cases, sclerosis can be found at the base of the cranium<sup>4</sup> due to an endochondral ossification defect, suggesting the possibility of two forms of progressive diaphyseal dysplasia: a pure one, with exclusive disturbance in intramembranous ossification, and a mixed one, in which there is also the endochondral component.<sup>3</sup> Cranial nerve palsy may develop in such cases. Hearing loss occurs in 18% of cases and may be conductive, through fixation of the staples in the oval window, mixed or sensorineural, due to stenosis of the internal auditory meatus.<sup>7</sup>

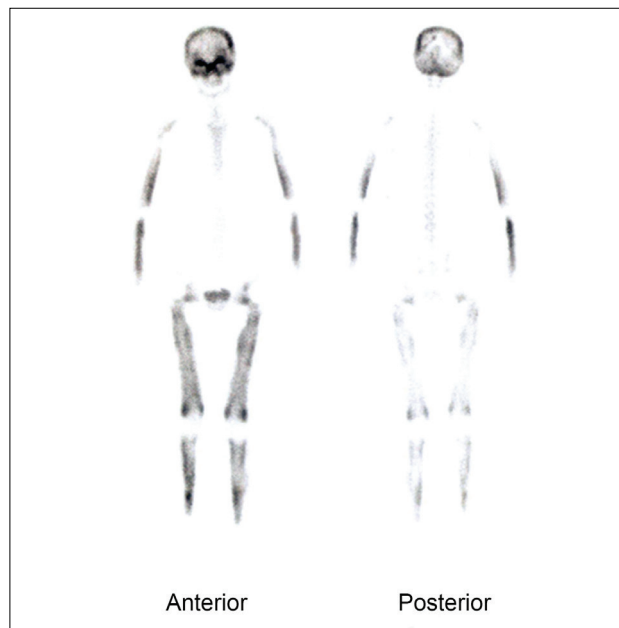
Unlike other bone metabolism disorders, in Camurati-Engelmann disease low-impact fractures are rare, and there is controversy about neuromuscular impairment<sup>1,5</sup> probably due to the wide variety of phenotypic expressions described.<sup>8</sup>

MRI is as effective as computerized tomography for demonstrating the hyperostotic bone, and the compressive effect on specific cranial nerves (mainly II, VII and VIII) can be characterized well.<sup>2</sup> Perhaps in the near future techniques such as high resolution peripheral quantitative computed tomography (HR-pQCT)<sup>9</sup> could provide additional information.

Increased osteoblast activity can be detected early through skeletal scintigraphy<sup>5</sup> even before the radiographic changes<sup>7</sup> or be normal in some cases.<sup>5</sup> In bone scintigraphy with <sup>99m</sup>Tc-MDP, heterogeneous abnormal uptake can be seen in the affected bones<sup>3</sup> in a bilateral and symmetrical manner<sup>1,6</sup> similarly to the findings of our study<sup>3</sup> (Figure 3).

## CONCLUSION

We were able to guide the diagnostic reasoning based on the image findings and clinical data. Knowledge of the different types of ossification was also fundamental to narrow down the range of differential diagnoses. MRI helps to improve the evaluation of the neuromuscular component in these cases and complements the radiographic images in the analysis of bone changes, in relation to their inflammatory activity and cortical thickening. Despite this being a rare disease whose treatment has been palliative through use of corticosteroids,<sup>2</sup> bisphosphonates (with controversial usage),<sup>5</sup> decompressive surgeries<sup>2</sup> and physiotherapy,<sup>5</sup> doctors must be aware of this possibility in order to avoid late diagnoses and to offer early multidisciplinary support to improve the quality of life of these patients.



**FIGURE 3** Bone scintigraphy after intravenous administration of <sup>99m</sup>Tc- MDP. Diffuse increase of osteogenic activity in the skull cap and long bones of the upper and lower limbs is observed, suggesting hereditary disease of the bone metabolism.

## REFERENCES

1. Bellew N, Wagener G. Camurati-Engelmann disease. *SA J Radiol.* 2011; 15(1):20-4.
2. Applegate LJ, Applegate GR, Kemp SS. MR of multiple cranial neuropathies in a patient with Camurati-Engelmann disease: case report. *AJNR Am J Neuroradiol.* 1991; 12(3):557-9.
3. da Fonte AC, Gonçalves CM, Catalan J, Justino Junior RO. Doença de Camurati-Engelmann: relato de caso com acometimento ósseo grave. *Radiol Bras.* 2005; 38(6):471-2.
4. Ihde LL, Forrester DM, Gottsegen CF, Masih S, Patel DB, Vachon LA, et al. Sclerosing bone dysplasias: review and differentiation from other causes of osteosclerosis. *RadioGraphics.* 2011; 31(7):1865-82.
5. Bogas M, Bogas V, Pinto F. Doença de Camurati-Engelmann: manifestações típicas de uma doença rara. *Rev Bras Reumatol* 2009; 49(3): 308-14.
6. Shier CK, Thrall JH, Kottamasu SR, Krasicky GA, Ellis BI. Diaphyseal bone disease: scintigraphic-radiographic correlation. *Radiographics* 1989; 9(1):129-51.
7. Antunes ML, Testa JRG, Frazatto R, Barbieri JAF, Silva RFND. Osteodistrofias raras do osso temporal. *Rev Bras Otorrinolaringol.* 2005; 71(2):228-32.
8. Janssens K, Vanhoenacker F, Bonduelle M, Verbruggen L, Van Maldergem L, Ralston S, et al. Camurati-Engelmann disease: review of the clinical, radiological, and molecular data of 24 families and implications for diagnosis and treatment. *J Med Genet.* 2006; 43(1):1-11.
9. Fuller H, Fuller R, Pereira RMR. Tomografia computadorizada quantitativa periférica de alta resolução para avaliação de parâmetros morfológicos e funcionais ósseos. *Rev Bras Reumatol.* 2015; 55(4):352-62.