Skeletal Radiol (1999) 28:107–110

CASE REPORT

S. Gil
S.F. Marco
J. Arenas
J. Irurzun
T. Agullo
S. Alonso
F. Fernandez

Doppler duplex color localization of osteoid osteomas

Received: 4 May 1998;
Revision requested: 3 June 1998;
Revision received: 2 November 1998;
Accepted: 4 November 1998

S. Gil, M.D. (✉) · J. Arenas, M.D.
J. Irurzun, M.D. · T. Agullo, M.D.
S. Alonso, M.D. · F. Fernandez, Ph.D.
Department of Diagnostic Radiology,
Universitary General Hospital of Alicante,
c. / Pintor Baeza s.n.,
E-03010 Alicante, Spain

S.F. Marco, M.D.
Department of Diagnostic Radiology,
Castellon Hospital General, Castellon, Spain

Abstract We present two cases of osteoid osteoma in adolescent boys. The lesions were located in the proximal metaphysis of the right tibia and left femoral diaphysis respectively. Doppler duplex color study demonstrated clearly the highly vascular nidus and its feeding artery in one case and only the feeding artery in the second. We believe these are the first descriptions of osteoid osteomas assessed with Doppler duplex color, which was also used as guidance for the percutaneous localization and biopsy.

Key words Osteoid osteoma · Tibia · Femur · Ultrasound · Doppler duplex · Color Doppler · Percutaneous localization

Introduction

Osteoid osteoma is a distinctive benign lesion of unknown origin, which contains a highly vascular central nidus, surrounded by a zone of reactive sclerosis [1].

Its radiographic, cross-sectional imaging, angiographic and scintigraphic features have been widely described in the literature. However, the ultrasound characteristics of this tumor, as in other bone lesions, have hardly been described.

We report the color Doppler characteristics of two osteoid osteomas which, to our knowledge, have not been described in the literature. We explore the possibility of using this technique as a guide for percutaneous localization or biopsy.

Case reports

Case 1

An otherwise healthy 16-year-old male, presented with a 2-month history of chronic pain in his right popliteal space. The pain was slightly worse at night and partially relieved with nonsteroidal anti-inflammatory drugs. On physical examination the patient had moderate limitation of flexion in his right knee. Radiography showed a 1-cm radiolucent, ovoid cortical lesion in the posterior margin of the proximal metaphysis of the right tibia, with little surrounding sclerosis (Fig. 1A). CT depicted the same findings: a small subperiosteal lytic lesion with mild peripheral sclerosis, slightly expanding the thinned cortex without break through (Fig. 1B). T2-weighted MRI (gradient sequence: TR/TE=825/25, FA=25°) showed an isointense lesion with extensive peripheral edema (*not shown*).

Ultrasound examination of the popliteal area was performed, and the lesion was observed as an irregularity of the cortical bone, surrounded by an echogenic area due to edema (Fig. 1C).

On color Doppler duplex study a Doppler signal was found within the cortical irregularity with clear pulsating flow (Fig. 1D). The spectral analysis showed an arterial curve of middle resistivity.

Ultrasound-guided percutaneous biopsy was performed, with a 14-G trephine needle (Ostycut, Angiomed, Germany) under standard aseptic and anesthetic technique after i.v. sedation (2 mg midazolam) (Fig. 1E). Pathologic diagnosis revealed an osteoid osteoma. The biopsy was not especially painful or bloody and there were

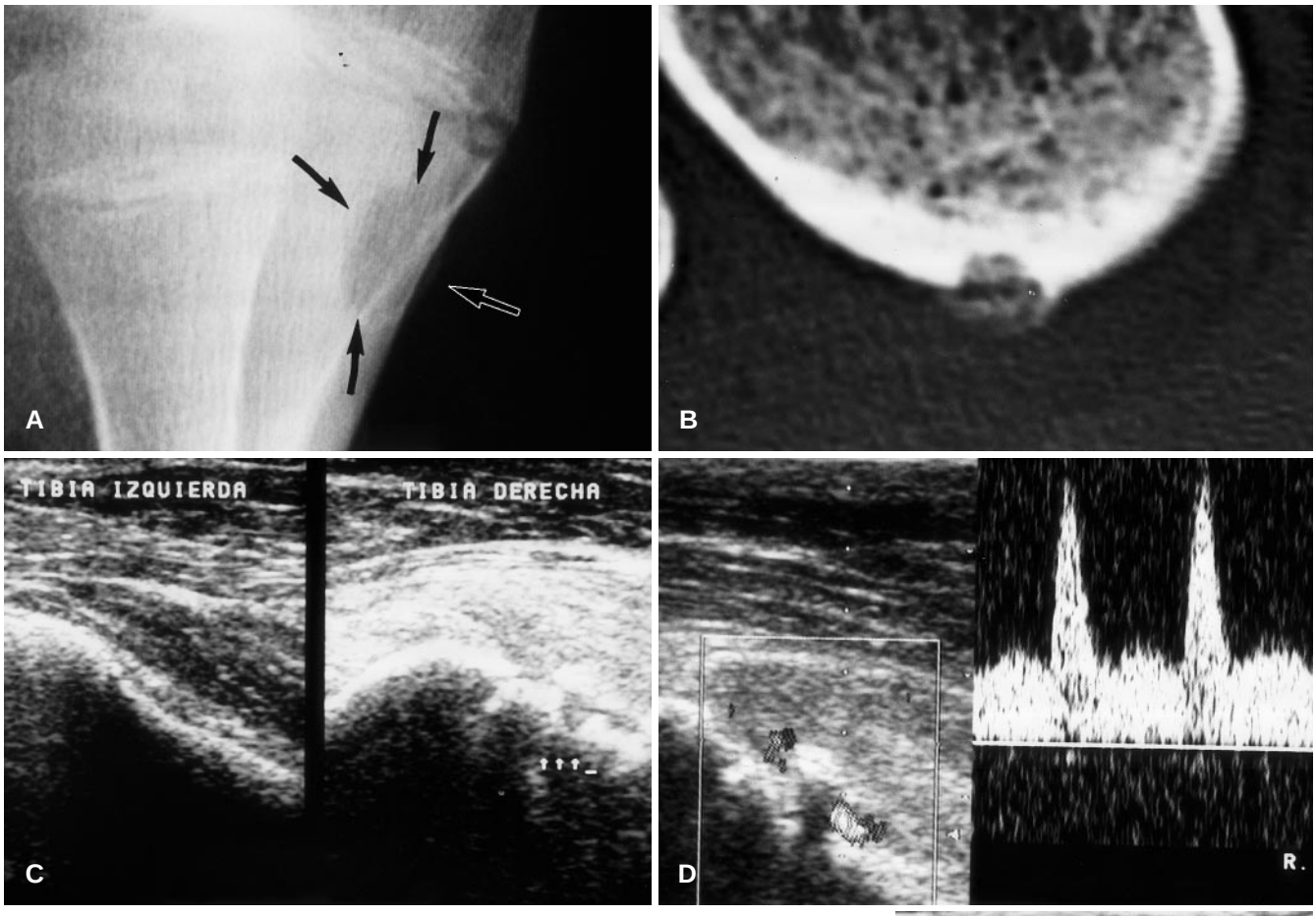

Fig. 1A–E Case 1. **A** Radiograph shows a geographic radiolucent lesion (*arrows*) in the posterior margin of the right proximal tibial metaphysis. **B** Unenhanced CT scan shows a 1-cm well-defined cortical lytic lesion, with scarce surrounding sclerosis. The cortex was thinned and slightly expanded, but not disrupted. **C** Comparative sagittal ultrasound scan of both popliteal spaces. On the right, there is cortical irregularity. The echogenic area represents intense peripheral edema. **D** Doppler duplex color study shows arterial spectral imaging within the nidus. **E** Percutaneous needle (*arrows*) biopsy was performed with ultrasound guidance

no complications. Percutaneous nidus ablation was not attempted and the patient was operated. The histological diagnosis was confirmed at surgery.

Case 2

A 17-year-old male complained of diffuse pain in his left knee. An MRI study of both knees was performed and read as normal. The patient continued to complain of pain at a higher level. Radiography of both legs revealed extensive sclerosis on the lateral margin of his left femoral metaphysis, with a small central notch (Fig. 2A). CT showed important sclerotic reaction, with a 3-mm nidus in it. Ultrasound study showed irregular cortex in the affected area and interruption of the cortex corresponding to the notch observed on the radiograph (Fig. 2B). On the Doppler duplex color study an arterial vessel was seen entering the notch. The spectral characteristics were exactly as in the previous case (Fig. 2C). The nidus and surrounding edema could not be seen.

An ultrasound-guided wire localization of the "notch" was performed just before surgery (Fig. 2D), to facilitate finding it at surgery and to

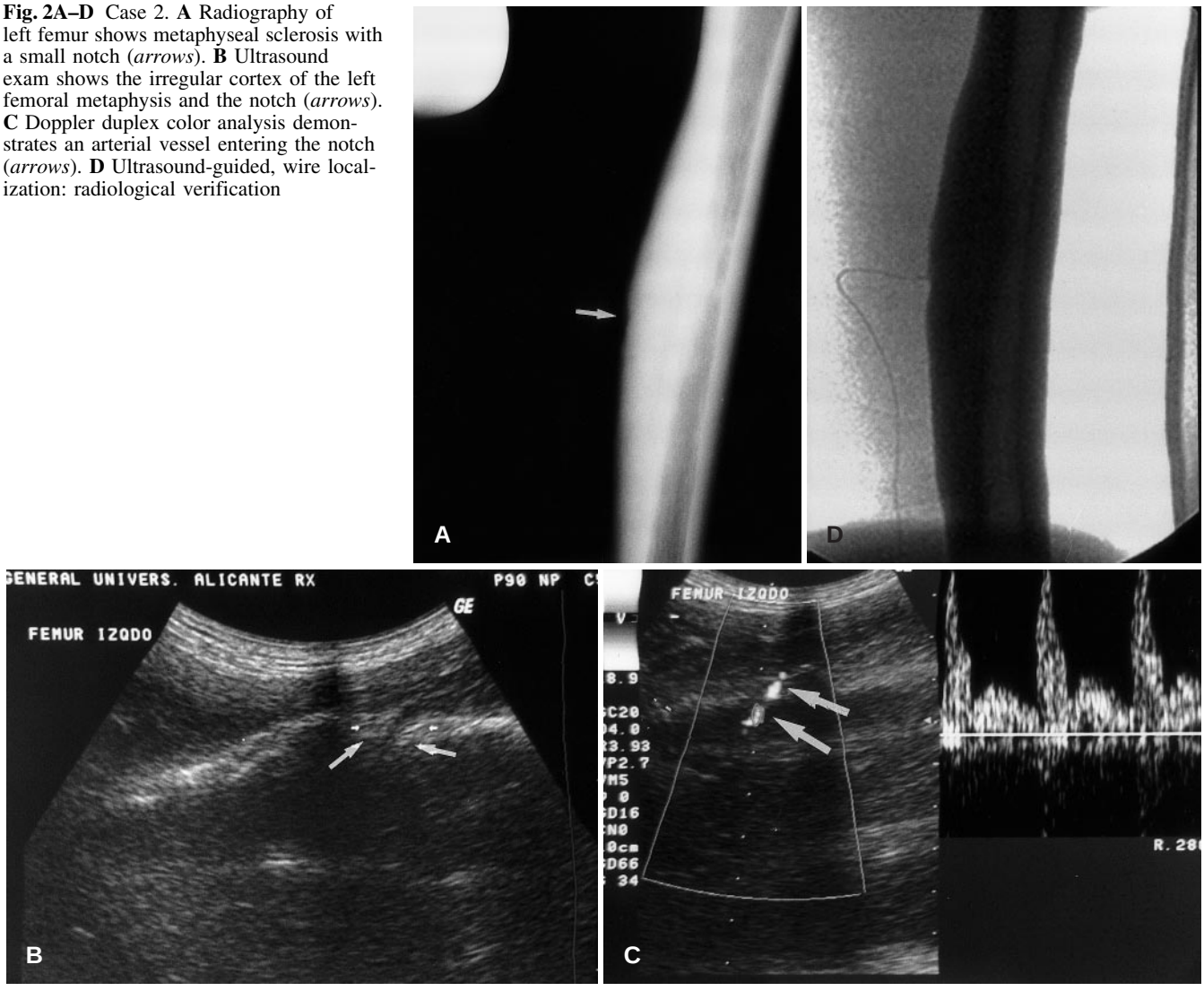

Fig. 2A–D Case 2. **A** Radiography of left femur shows metaphyseal sclerosis with a small notch (*arrows*). **B** Ultrasound exam shows the irregular cortex of the left femoral metaphysis and the notch (*arrows*). **C** Doppler duplex color analysis demonstrates an arterial vessel entering the notch (*arrows*). **D** Ultrasound-guided, wire localization: radiological verification

avoid ablation of normal bone. A standard breast localization wire was placed under echo Doppler guidance. We inserted the tip of the localization wire just next to the notch. The patient went to the operation room with the inserted wire fixed with a surgical bandage and wrapped with sterile wraps. The wire helped the orthopedic surgeons to find the tiny nidus surrounded by an intense sclerotic reaction. The pathologist confirmed the presence of osteoid osteoma in the excised piece.

Discussion

Osteoid osteoma is a common benign bone tumor, which was first identified as a distinct pathologic entity by Jaffe in 1935 [2].

The clinical and radiographic features of osteoid osteoma have been well described [1, 3, 4].

The nidus of osteoid osteoma is typically highly vascular. Because of this marked vascularity, a hypertrophic artery feeds the nidus. The latter characteristic has been used to demonstrate and diagnose osteoid osteoma on angiography and scintigraphy.

Several techniques have been described for preoperative nidus localization to ensure its complete removal. Steinberg et al. reported the placement of a 0.0028 mm C wire over the nidus with CT guidance [5]. Other authors have advocated the preoperative administration of radioactive isotopes that become concentrated in the nidus and localized with a probe intraoperatively [6]. Ziegler and Scheid reported a case in which preoperative localization was carried out with an Ackerman needle dipped in methylene blue, and a 2-mm hole was bored in the cortical bone overlying the nidus [7].

In case 2, a standard localization wire was used, typically employed in preoperative localization of breast lesions. This procedure is cheap, easy to perform, and widely available. While we chose to use ultrasound guidance, due to our personal experience and preference, CT-guided wire placement can also be used.

Newer methods of imaging-guided ablations of these tumors have been described in recent years, using different kinds of needles and drills, all of them under CT guidance [8–11]. Because of our limited experience we did not attempt to percutaneously remove the nidus. However, we believe CT would be the preferred imaging technique for this purpose. Due to the capability of Doppler to provide a visual representation of vascular flow, this technique can be used to assess the vascularity of the nidus and its feeding artery to guide nidus localization.

In the first case, the Doppler signal clearly depicted not only the feeding artery, but also the nidus. The clear Doppler signal within the nidus was probably due to its peripheral location and thin margin.

In both cases, we performed comparative Doppler duplex color ultrasound scan of the contralateral extremity and failed to observe a bone feeding artery, which could be confused with the artery that feeds the nidus.

We did not perform measurements such as a peak systolic or telediastolic velocity, or any index. However, the morphology of the spectral analysis showed arterial flow of middle resistivity in both cases.

Although more experience is needed, identification of the highly vascular nidus or the feeding artery could help differentiate osteoid osteoma from other lesions, such as Brodie's abscess and Langerhans cells histiocytosis [3], where a central vascular area and hypertrophied arterial vessel are absent.

We have studied two additional cases with radiologic findings and symptoms suspicious for osteoid osteoma. In these, an exhaustive Doppler duplex color study failed to show any pathologic vessels or flow within the lesion. The final diagnosis in these cases was osteomyelitis and fibrous cortical defect, respectively.

In conclusion, the ability of color Doppler duplex ultrasound to detect subtle changes in the vascular flow, which typically occurs in osteoid osteoma, allows wire localization and percutaneous treatment of osteoid osteomas, especially if peripherally located. More experience is needed to demonstrate the usefulness of this technique in detecting and diagnosing osteoid osteoma. We encourage radiologists to use this cheap, non-invasive and radiation-free technique in similar lesions to those described herein.

Note added in proof. Since acceptance of this paper, the authors have used ultrasound to demonstrate a feeding artery in an additional osteroid osteoma located in the tibia

References

1. Resnick D, Niwayama G. Diagnosis of bone and joint disorders. Philadelphia London Toronto: Saunders, 1981:2656.
2. Jaffe HL. Osteoid osteoma: a benign osteoblastic tumor composed of osteoid and atypical bone. Arch Surg 1935; 31:709–728.
3. Hossein F, Cornelia NG, Mahvash R, Wolfgang R, Jeffrey CW. Imágenes por RM y TC del sistema musculoesquelético. St Louis Baltimore Boston: Mosby, 1993:359–360.
4. Kransdorf MJ, Stull MA, Gilkey FW, Moser RP. Osteoid osteoma. Radiographics 1991; 11:671–696.
5. Steinberg GG, Coumas JM, Breen T. Preoperative localization of osteoid osteoma: a new technique that uses CT. AJR 1990; 155:883–885.
6. Ghelman B, Thompson FM, Arnold WD. Intraoperative radioactive localization of an osteoid osteoma. Case report. J Bone Joint Surg 1981; 63:826–827.
7. Ziegler DN, Scheid K. A method for location of an osteoid osteoma of the femur at operation. A case report. J Bone Joint Surg 1992; 74:1549–1552.
8. Towbin R, Kaye R, Meza MP, Pollock AN, Yaw K, Moreland M. Osteoid osteoma: percutaneous excision using a CT-guided coaxial technique. AJR 1995; 164: 945–949.
9. Assoun J, Railhac JJ, Bonnevialle P, et al. Osteoid osteoma: percutaneous resection with CT guidance. Radiology 1993; 188:541–547.
10. Roger B, Bellin MF, Wioland M, Grenier PH. Osteoid osteoma: CT-guided percutaneous excision confirmed with immediate follow-up scintigraphy in 16 outpatients. Radiology 1996; 201:239–242.
11. Mazoyer JF, Kohler R, Bossard D. Osteoid osteoma: CT-guided percutaneous treatment. Radiology 1991; 181:269–271.