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Case Report

Computed tomography guided radiofrequency ablation of multifocal osteoid osteoma ☆

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ARTICLE INFO

Article history:
Received 28 April 2020
Revised 23 May 2020
Accepted 24 May 2020

Keywords:
Multifocal osteoid osteoma
Radiofrequency ablation
Computed tomography
Magnetic resonance

ABSTRACT

Osteoid osteoma is a benign osteoblastic tumor characterized mostly by presence of one nidus, butvery infrequentlyniduses can be multiple. Radiofrequency ablation is a well-established treatment method for this disease. We report a case of a 19-year-old male patient with bifocal osteoid osteoma which was partially missed on the initial magnetic resonance imaging and treated successfully with two sessions of radiofrequency ablation. Following the second session of ablation, the pain resolved immediately and the patient remains pain-free for 6 months since the procedure. Our case report underlines the fact that although very rare, multifocal osteoid osteomas do exist and its niduses can be obscured during the magnetic resonance imaging due to the edema. It emphasizes the role of the initial computed tomography evaluation.

Osteoid osteoma (OO) is a benign osteoblastic tumor of unknown etiology first described by Bergstrand in 1930. It is characterized by presence of the nidus with the size up to 15 mm, surrounded by the sclerotic bony tissue. The nidus represents the accumulation of prostaglandin-secreting cells which are responsible for the pain as a main symptom. On a later stage, pain is aggravated during night-time and may spread across the whole extremity. Pain caused by OO is prone to nonsteroidal anti-inflammatory drugs which relieve the pain by inhibiting cyclooxygenase-2 enzyme and subsequently the synthesis of prostaglandins.

The workup process of OO involves the assessment of the clinical history, radiological studies, and occasionally pathomorphological data. OO, especially if small, can be obscured by reactive bone sclerosis, and overlooked on a conventional

☆ Acknowledgments: Authors acknowledge the director of the Tbilisi Central Hospital, Dr. George Lobzhanidze, MD, PhD for his support in editing the manuscript.
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https://doi.org/10.1016/j.radcr.2020.05.048

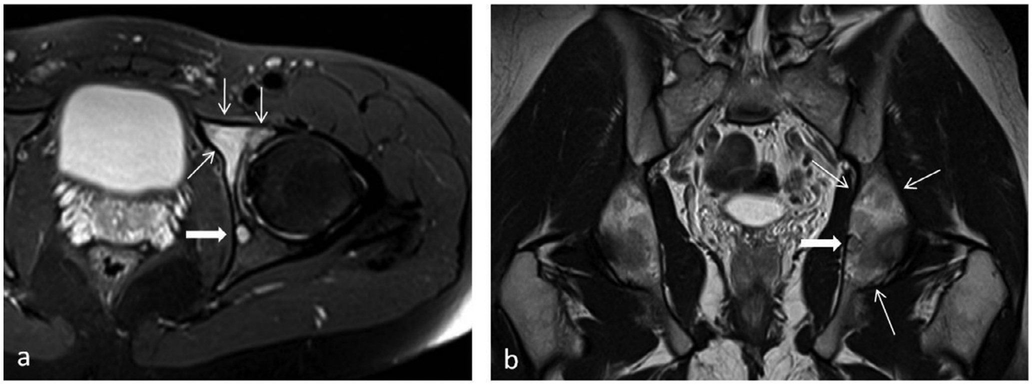

Fig. 1 – Axial pd (a) and coronal t2 tse (b) images show hyperintense nidus in the posterior acetabulum surrounded by the hypointense rim consistent with the sclerosis (thick arrow) with the adjacent edema (thin arrows).

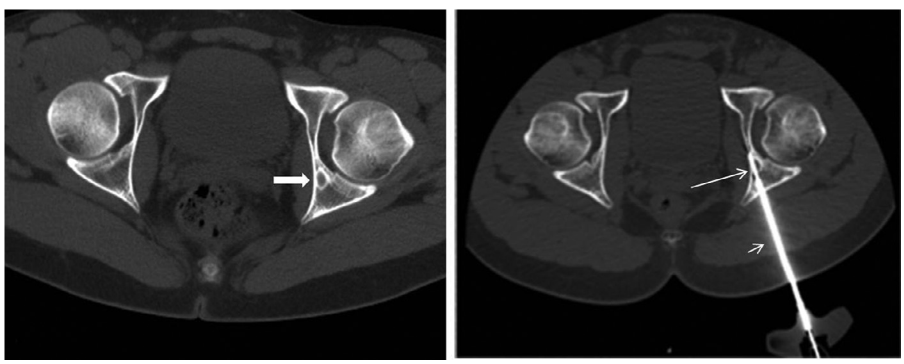

Fig. 2 – (a) Computed tomography image before the RFA procedure shows the hypodense nidus (thick arrow) surrounded by the slcerotic rim. (b) CT image during the ablation shows the active tip of the radiofrequency electrode (thin long arrow) inside the nidus of the OO advanced coaxially through the bone drilling needle (thin short arrow).

X-ray. In this setting, computed tomography (CT) may be helpful as an early identification tool [1,2]. Gadolinium-enhanced magnetic resonance imaging (MRI) can also depict OO nidus with high accuracy and additionally, show bone edema.

The main objective of OO management is to control pain. There are several methods (1)conservative treatment with the NSAIDs; (2) surgical en-bloc resection of the lesion; and (3) thermal ablation of the tumor. Currently, CT-guided percutaneous radiofrequency ablation (RFA) is considered a standard of care [3].

Usually OO has one nidus. Very infrequently, niduses can be multiple, presenting as multifocal or multicentric lesion [4, 5]. *Multifocal OO* refers to more than one lesion within the same skeletal segment, whereas *synchronous multicentric OO* is related to the simultaneous presence of OOs in different bones. Last, a single lesion with more than one nidus is termed as *OO with multicentric nidus* [3, 4].

In this paper, we report a case of a bifocal OO, which was partially overlooked on the initial MRI) and had to be treated with 2 sessions of radiofrequency ablation.

Case report

A 19-year-old male patient presented to the department of interventional radiology with 1-year history of pain in the femoral region. The pain worsened during the physical activity and nighttime. The patient had been treated with NSAIDs. Radiologic studies included x-ray of the thigh (not shown) and MRI scan of the pelvis (Fig. 1). The later was typical for the OO with 10-mm nidus in the posterior portion of the acetabulum and the extensive edema in the adjacent bone. The patient was referred to our department for radiofrequency ablation by the orthopedic surgeon, as the surgical intervention is usually associated with increased morbidity. The surgical intervention to the posterior wall of the femoral neck requires the standard or minimally invasive surgical posterior approach to the hip joint. The technique includes incision of the piriformis and obturator internus tendon, T-shape cut of the capsule and luxation of the femoral head if needed. The possible complications of the procedure are sciatic nerve palsy and aseptic necrosis of the femoral head.

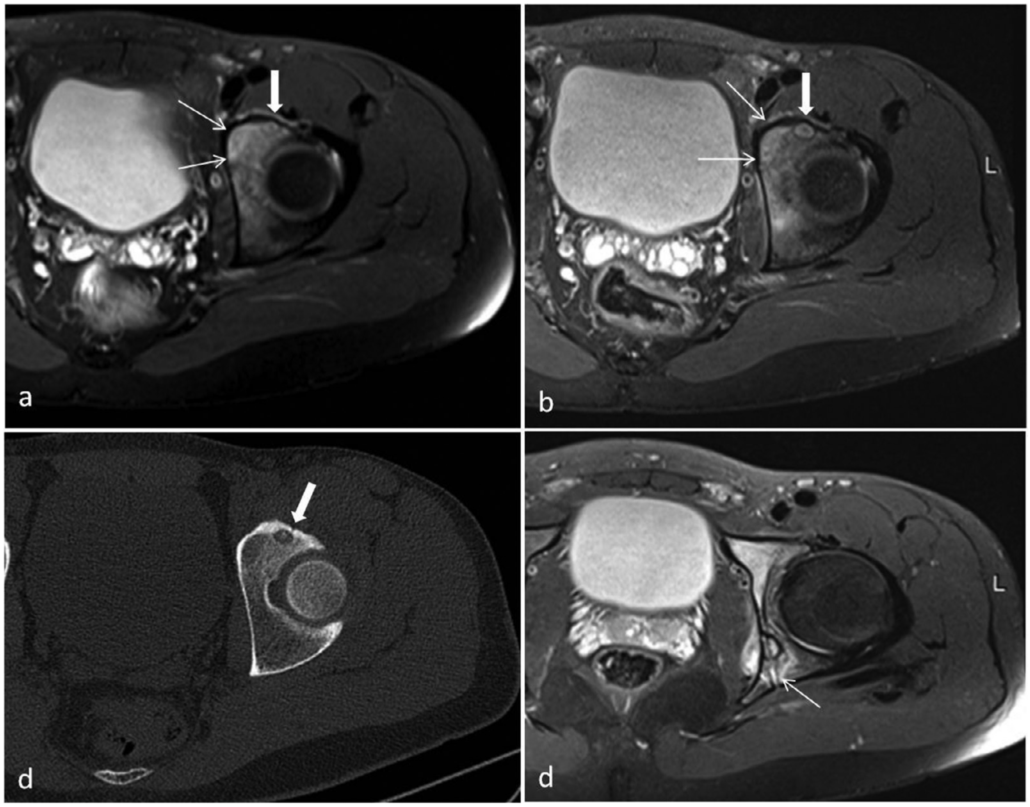

Fig. 3 – (a) Pretreatment MRI. Nidus in the anterior acetabulum (thick arrow) is obscured by the edema (thin arrows). (b) In the postablation MRI scan the second nidus (thick arrow) can be easily identified. (c) CT image the same day and same level identifies the nidus with central mineralization even better. (d) Postablation needle tract as a consequence of the performed RFA procedure

CT-guided RFA was performed with general anesthesia (Fig. 2). The nidus was accessed with the bone biopsy needle (Osteo-Site Murphy, Cook Medical, Bloomington, USA). After verifying the needle position, the inner stylet was removed and radiofrequency electrode with the 15-mm active tip (Big Tip, RF Medical, Seoul, South Korea) was introduced coaxially inside the lesion. Ablation was done with Mygen M-3004 generator (RF Medical, Seoul, South Korea). Thermal destruction of the nidus was performed by heating up the active tip of the electrode up to about 90°C for 6 minutes. The pain was relieved after the procedure; patient was discharged without any complaints.

Four days after the discharge, the pain recurred. He was reconsulted by the orthopedic surgeon and interventional radiologist. Repeat MRI revealed another 6-mm sized nidus in the anterior margin of the acetabulum (Fig. 3b). The presence of the nidus was verified with the CT scan (Fig. 3c). Needle track leading to the posterior nidus was also identified (Fig. 3d), confirming high technical success of the conducted ablation procedure.

Another CT-guided RFA procedure was performed with spinal anesthesia. Unlike the previous procedure, the biopsy specimen for the pathomorphological study was obtained. Bonopty Penetration Set and Bonopty Biopsy Set (Apriomed, Uppsala, Sweden) were used to create the access to the nidus and obtain the biopsy sample. The rest of the procedural steps and equipment were the same as described above. Pain resolved immediately after the procedure (Fig. 4). The diagnosis of osteoid osteoma was confirmed by pathomorphological study findings (Fig. 5). The patient was discharged without any pain and remains pain-free for 6 months up to present.

Discussion

OO typically develops in the cortical region of the long bones of lower extremities, although it may have intramedullary or subperiosteal location, and may arise in any bone [6, 7]. It usually has one nidus. Occasionally, OO may have a multifocal presentation. To our knowledge, only about 30 such cases have been described. Early detection is important to establish an appropriate management [8]. Multifocality should be distinguished from the multicentricity, a characteristic referring to the development of a primary OO in more than one bone [9].

In our case, the patient was affected with multifocal OO as far as both nidi were located in the acetabulum. The first nidus was successfully ablated during the first procedure. The second one was not identified on the initial cross-sectional scan. The reason was that there was an extensive bone marrow edema in the whole acetabular region in which the anteriorly located nidus was obscured. On the follow up postabla-

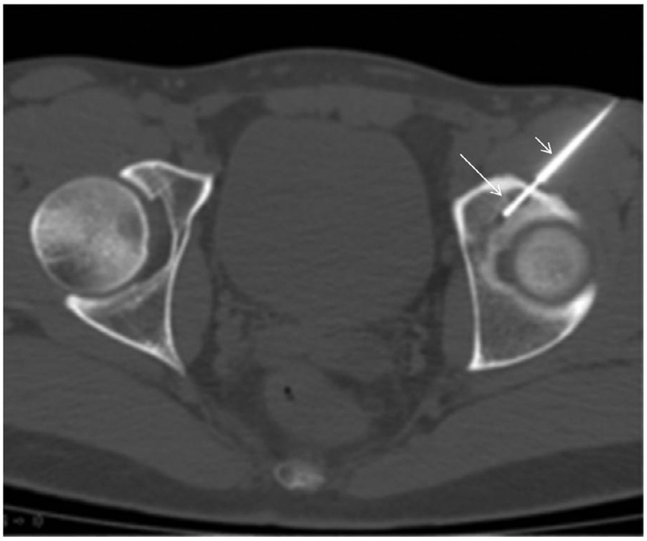

Fig. 4 – Computed tomography image during the second ablation procedure shows the active tip of the radiofrequency electrode (long arrow) inside the nidus of the OO advanced coaxially through the bone drilling needle (short arrow)

tion MRI scan the edema was partially resolved and the nidus became visible.

Plain radiography is usually the first line examination, but may result in inconclusive findings, especially in cases of intramedullary lesions or tricky locations (e.g., spine, pelvis, hands, and feet) [10]. CT allows better localization of the nidus and is the imaging modality of choice, used to guide RFA procedure [10]. MRI can be used as a problem-solving tool, especially when the lesion arises in uncommon sites, such as juxta-articular or intramedullary. Although sensitive, MRI is not highly specific and is often unable to identify the nidus. However, it has high accuracy if the contrast is applied and the nidus is seen. Occasionally, the diagnosis of OO requires biopsy and pathomorphological verification. This is usually reserved for the equivocal cases, when the noninvasive diagnosis cannot be made.

In our case, initially, after the nonspecific findings on the x-ray, the MRI was used as a diagnostic tool, as differential diagnoses included other diseases than OO. CT was not used since the MRI identified the first nidus and showed a specific picture of the OO. Radiological picture correlated well with the clinical findings. There is one more issue to address: we performed the RFA procedure under the CT guidance and the treatment planning CT was the first CT scan before the relapse of the pain. When doing the CT-guided interventions, we always try not to use a big scan range and spare the patient (particularly young individuals) from the excessive radiation exposure. The second nidus was located 4 cm cranial to the first one and was not included in the scan area made for the planning of the intervention.

After the identification of the second nidus, previous (pre-RFA) MRI scan was reviewed retrospectively (Fig. 3a). The second (anterior) nidus was barely identifiable in the pre-procedure MRI scan and only with help of postprocedure MRI or CT scans, taken as a reference. On the CT scan, which was done the same day as post-RFA MRI scan, both nidi were adequately identified without any difficulties. Nevertheless, we questioned the diagnosis due to the extreme rarity of the multifocal OO and confirmed it with the biopsy and pathomorphology.

Repeated procedures for the treatment of OO are not uncommon. They are obligated by the recurrence after the initial intervention. Frequently, the pain relapse is the outcome of an incomplete treatment procedure rather than true recurrence. In our case the incomplete ablation was not an issue as both ablations were performed with high technical accuracy. However, clinically successful was the second procedure. If both nidi had been identified initially, the RFA procedure would probably involve the ablation of both lesions during the single procedure. This approach would be justified by the fact that the patient would not undergo the anesthesia twice and the duration of the pain would be shorter.

Surgery of OO has been traditionally used as standard of care. Currently, RFA represent the best treatment option, allowing to treat the nidus by thermal coagulation through a

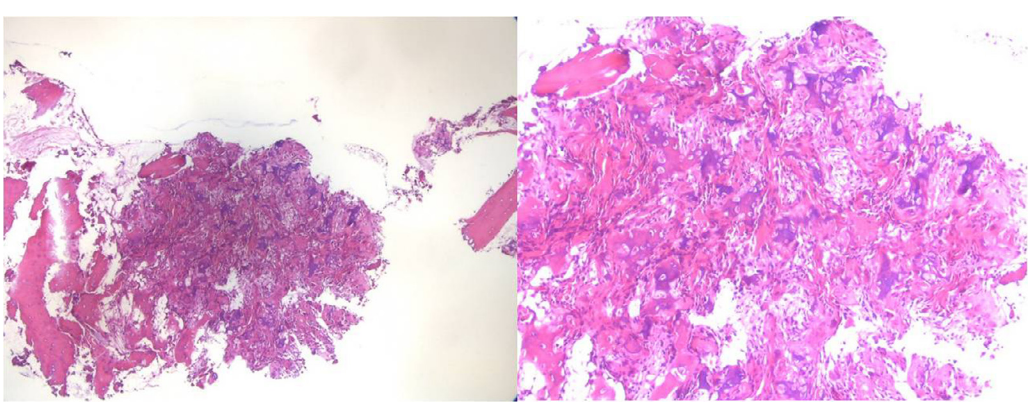

Fig. 5 – Photo micrograph with H&E stain, x40 and x100. Fragments of anastomosing, irregular trabeculae, sclerotic nidus of woven bone with variable mineralization. Bone trabeculae rimmed by single layer of osteoblasts and foci of osteoclasts. Stroma is fibrovascular.

percutaneous approach, with well documented safety, and success rates higher than 90% [10–12]. One of the factors predisposing to the under-treatment appears to be the size of the nidus exceeding 10 mm. In such cases needle repositioning (creating another access in the nidus followed by ablation) may overcome the risk of unsuccessful procedure. At the department of interventional radiology we treat OO with the CT guided RFA. We do the ablation in all locations of the skeleton except for hand and spine, because it is believed that the hyperthermia in these areas can damage adjacent neural structures [14]. If the lesion is located within a joint capsule, it may cause joint swelling, synovitis, and restricted mobility [13]. After RFA fracture complications can occur and usually require surgical treatment. However, if the patients with lower extremity lesions are advised to avoid difficult exercises and contact sports for 3 months after the procedure, majority of the fractures can be prevented [14].

In conclusion, this is the rare case of multifocal OO treated with 2 sessions of the RFA. Our case report underlines the possibility of the multiple nidi which can be obscured during the MRI. It may be reasonable to obtain CT confirmation in some OO cases, even with conclusive MRI findings. Another option can be the optimization of MRI scanning protocols and using cross-sectional subtraction in patients with the extensive bone edema. These issues should be a matter of the further investigation.

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