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CASE REPORT

MR imaging and ultrasonography findings of early myositis ossificans: a case report

Kyung Ryeol Lee[1] · **So Young Park**[2] · **Wook Jin**[2] · **Kyu Yeoun Won**[3]

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Abstract Myositis ossificans (MO) is a benign soft tissue lesion with non-neoplastic heterotopic bone formation. MO in the intermediate and mature stages can be easily diagnosed if characteristic imaging findings such as a peripheral zonal pattern of ossification with variable thickness is observed. However, it is difficult to correctly diagnose early MO because it can mimic malignancy clinically, radiologically, and histopathologically. We report a case of early pseudosarcomatous phase of non-traumatic MO with atypical imaging findings. A 59-year-old woman presented with pain followed by a mass in the left thigh within a week. MR imaging and ultrasonography showed an intramuscular lesion with preserved muscle fascicles in the vastus lateralis muscle. Intralesional ossification or calcification was not seen on ultrasonography. A diagnosis of myositis ossificans was made by ultrasonographically guided biopsy.

Keywords Myositis ossificans · Magnetic resonance imaging · Ultrasonography

✉ So Young Park
balgundol@hanmail.net

[1] Department of Radiology, Jeju National University Hospital, Aran 13 gil 15 (Ara-1-dong), Jeju-si, Jeju Special Self-Governing Province 63241, Republic of Korea

[2] Department of Radiology, Kyung Hee University Hospital at Gangdong, 892, Dongnam-ro, Gangdong-gu, Seoul 134-727, Republic of Korea

[3] Department of Pathology, Kyung Hee University Hospital at Gangdong, 892, Dongnam-ro, Gangdong-gu, Seoul 134-727, Republic of Korea

Introduction

Myositis ossificans (MO) is characterized as a benign, solitary, self-limiting, ossifying soft-tissue mass [1]. MO may be related to trauma, burns, and paralysis, but may also appear without any significant history [2]. The most common locations are the muscles of the thigh and upper arm, particularly the anterior muscles [3]. The clinical features are dependent on the stage of MO. The initial symptoms are painful swelling and decreased range of motion, but in the later stages, pain and swelling diminish [1, 3, 4]. The typical imaging and histopathologic findings of MO is a zonal pattern with a nonossified center, intermediate immature osteoid formation, and peripheral mature bone [3]. Early MO without ossification or calcification can easily be misdiagnosed as malignancy or infection [2, 5]. A few reports of acute MO without calcifications or zonal pattern on imaging studies have been published [4, 6–8]. We present an unusual case of early MO in a 59-year-old woman with emphasis on MR imaging and ultrasonography findings, an intramuscular mass with a pattern of edema and no ossification.

Case report

The study was approved by our institutional review board, and the requirement for informed consent was waived for this case report. A 59-year-old woman presented with a 1-week history of severe pain in the anterolateral aspect of her left thigh, followed by the appearance of a mass in the affected area for a few days. There was no history of antecedent trauma. Her past medical and family histories were unremarkable. Physical examination showed a mass and mild tenderness in her left anterolateral thigh. MR imaging was performed. Radiographs of the left thigh and laboratory tests were not performed. MR imaging of the left thigh showed a 6.5 × 3.7 × 2.6-cm sized

lesion in the vastus lateralis muscle, in which preservation of the muscle fascicles and perimysia, focal enlargement, and intense enhancement were noted. The margin of the lesion was predominantly well defined aside from one small section that was ill-defined. A "checkerboard-like pattern" which was firstly described on CT in the setting of proliferative myositis by Yigit et al. [9], was noted in the lesion on axial T2-weighted images. Surrounding soft tissue edema and enhancement were seen in the vastus lateralis muscle, overlying fascia, and subcutaneous layer (Fig. 1a–d). One day later, ultrasonography was performed. Ultrasonography revealed an intramuscular lesion with edematous muscle fascicles, thickened and anechoic perimysia, and indistinctness between the muscle fibers and endomysia. Transverse ultrasonography scan showed a "checkerboard-like pattern" within the lesion (Fig. 2a–b). Vascularity in the lesion was seen (not shown). Lymphoma, malignant soft tissue tumor, and hematoma were included in the differential diagnosis. Ultrasonography-guided biopsy was performed on the same day. On pathologic examination, the majority of the biopsy specimen was composed of immature, loosely textured fibroblasts and myofibroblasts displaying a mild degree of cellular pleomorphism intermingled with a varying number of macrophages and chronic inflammatory cells. Mitotic figures were not identified. In a small portion of the biopsy specimen, ill-defined trabeculae consisting of a mixture of fibroblasts, osteoblasts, and osteoid were noted. Cytologically bland and monolayer osteoblasts were seen (Fig. 3). These histopathologic findings were compatible with a diagnosis of myositis ossificans. One month later, radiographs and follow-up ultrasonography were performed. The plain radiograph showed a 2.6-cm-sized calcification that was focal, linear, and faint. On follow-up ultrasonography, the lesion was markedly smaller and had a newly visible peripheral, irregular, and curvilinear calcification (Fig. 4).

Discussion

The clinical presentation, radiologic findings, and histopathologic findings of MO may change depending on the stage of its

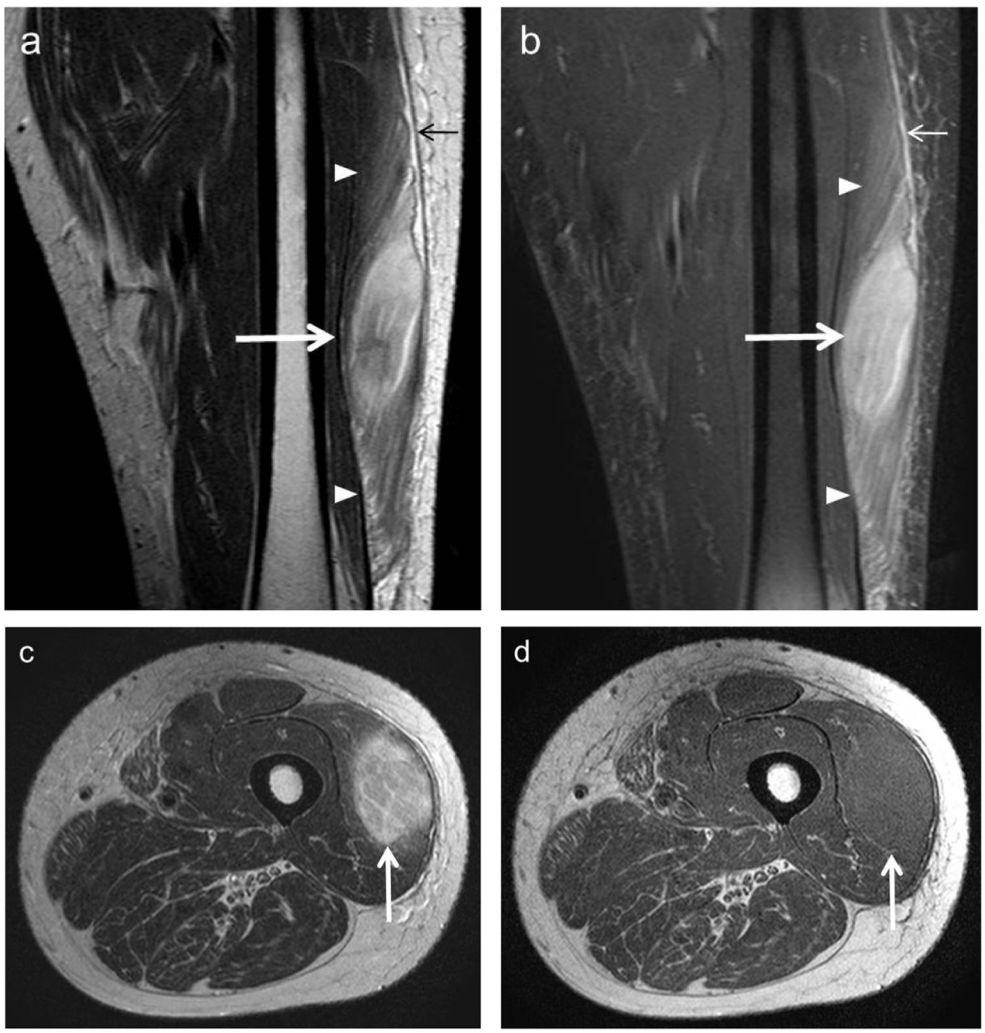

Fig. 1 MR imaging of the left thigh. **a** Coronal T2-weighted image shows an oval intramuscular mass-like lesion with a pattern of edema (*large white arrow*) in the vastus lateralis muscle. Surrounding soft tissue edema in the vastus lateralis muscle (*arrowheads*) and overlying fascia (*small black arrow*) is seen. **b** Enhanced fat-suppressed coronal T1-weighted image shows that the lesion enhances intensely (*large white arrow*). Preservation of the muscle fascicles is noted within the lesion. Enhancement with a striate pattern in the surrounding muscle (*arrowheads*), enhancement of the overlying fascia (*small white arrow*), and reticular enhancement of the overlying subcutaneous layer are seen. **c** Axial T2-weighted image reveals a hyperintense lesion with a "checkerboard-like pattern" in the vastus lateralis muscle. **d** Axial T1-weighted image shows an ill-defined isointense lesion in the vastus lateralis muscle

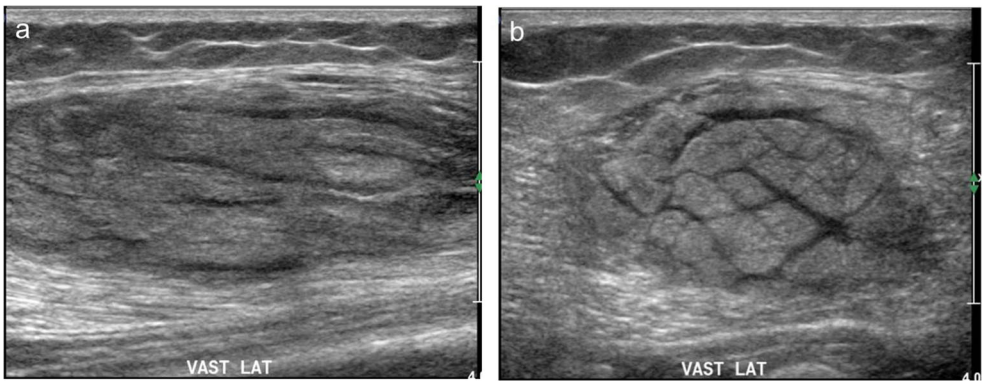

Fig. 2 Ultrasonography of the left thigh. **a** Longitudinal scan image shows an intramuscular lesion with enlarged but preserved muscle fascicles. Indistinctness between muscle fibers and endomysia within the lesion are also noted. **b** Transverse scan image reveals a "checkerboard-like pattern" of the lesion, probably due to the thickened and anechoic perimysia

evolution. Three stages are commonly described: early (<4 weeks), intermediate (4–8 weeks), and mature (>8 weeks) [1]. However, the duration of the different stages of MO varies between publications [1, 5]. In the early pseudosarcomatous stage, the lesion mainly consists of fibroblasts and myofibroblasts, with a minor component of osteoid formation. It may be difficult to distinguish MO from sarcoma on microscopy [3]. As the lesion matures, a centrifugal zonal pattern may develop. Immature osteoid formation gradually organizes into mature bone on the periphery of the lesion. Therefore, a zonal pattern of varying thickness may be observed over time. Three distinct zones are described: the center consisting of proliferating fibroblasts with areas of hemorrhage and necrotic muscles, the intermediate or middle zone characterized by osteoblasts with immature osteoid formation, and the peripheral or outer zone consisting of mature bone. This typical zonal pattern may not be seen in some lesions. In the intermediate stage, there is no proliferative fibroblastic core or a minor one, but instead a main osteoid component and an outer shell of mature lamellar bone. In the mature stage, the lesion consists of mature lamellar bone [1, 3, 10, 11].

In the early stage, faint peripheral calcification may be seen in 7 to 10 days on radiograph [5]. On MRI, the intramuscular lesion is isointense or slightly hyperintense on T1WI and hyperintense on T2WI, and diffusely and markedly enhanced following the administration of contrast material. The margin may be ill-defined with prominent surrounding edema [5, 12]. Two previous reports of early MO with a pattern of muscle edema on MR imaging, such as in our case, have been published previously [4, 7]. Both cases of MO were atraumatic, with one patient experiencing a 1-week history of a palpable mass, and the other experiencing a 2-week history of a painful mass. The patient in our case also had a 1-week history of pain and swelling of the left thigh. Ultrasonography is useful in detecting early stage of MO before calcification may be seen on radiographs and can be used in monitoring MO. On ultrasonography, early MO is seen as a hypoechoic mass with or without calcifications and increased vascularity. There is no clear zonal demarcation in early MO [3, 5, 8, 13–15]. Abate et al. [8] reported on the sonographic findings of post-traumatic MOs, in which there was one case of early MO with ultrasonographic findings of thickened hypoechoic muscle without calcifications, such as in our case.

In the intermediate stage, peripheral calcifications of varying thickness are seen. Coarse, flocculent, or scattered central calcifications may be occasionally seen in the lesion. A rim of low signal intensity on the periphery and low signal intensity central foci are depicted in all sequences on MR imaging. On enhanced MR imaging, variable enhancement patterns are seen with reduced surrounding edema. In the mature stage, a well-defined densely calcified lesion is apparent. A well-defined lesion with low signal intensity and without

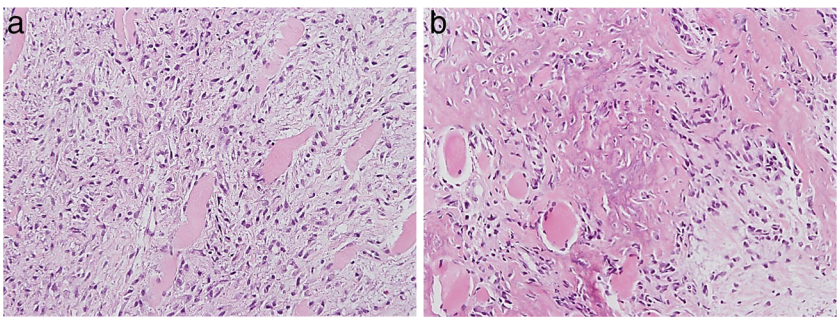

Fig. 3 **a** The specimen is mainly composed of immature, loosely textured fibroblasts with mild cellular pleomorphism. Mitotic figures are not identified. Entrapped atrophic or necrotic muscle fibers are identified. **b** A small portion of the specimen shows ill-defined trabeculae consisting of a mixture of fibroblasts, osteoblasts, and osteoid. The osteoblasts are monolayered with a cytologically bland appearance (H&E staining, ×200)

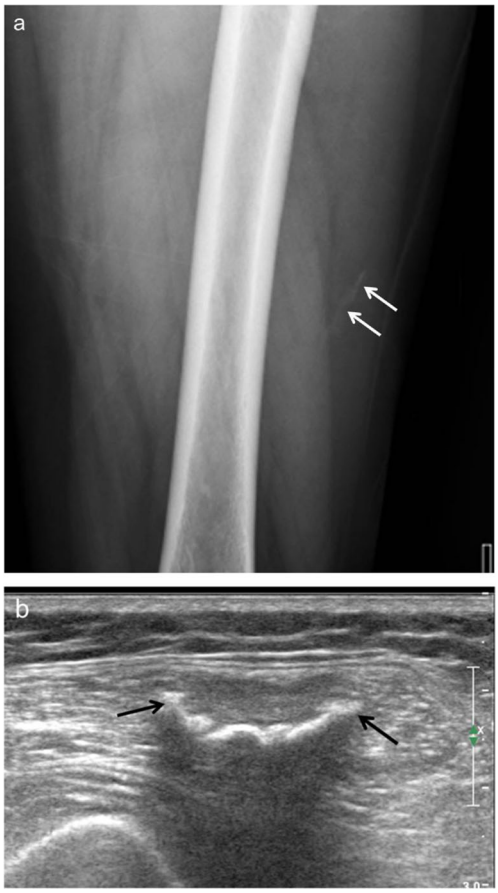

Fig. 4 Follow-up radiograph and ultrasonography 1 month later. **a** Radiograph of the left thigh shows a focal, linear calcification. **b** Ultrasonography examination reveals a smaller lesion with peripheral curvilinear calcification

surrounding edema has been noted on MR imaging [5, 10]. MOs with typical imaging findings such as peripheral calcifications and a zonal pattern of maturation can be easily diagnosed. However, lesions with marked surrounding soft tissue edema and without calcifications may mimic infection or malignancy. Although these lesions may have calcific areas, they may mimic malignancies such as extraskeletal osteosarcoma or synovial sarcoma because of its aggressive appearance, given the heterogenous signal intensity, heterogenous enhancement, and marked surrounding edema [7, 11, 12].

Our case had atypical MR imaging and ultrasonography findings with an intramuscular mass-like lesion with a pattern of muscle edema preserving the muscle fascicles. A "checkerboard-like pattern" in the lesion was noted on transverse ultrasonography scan as well as on axial T2-weighted MR images. The "checkerboard-like pattern" was first described on CT in the setting of proliferative myositis [9]. Jarraya et al. [16] reported that proliferative myositis had a "checkerboard-like pattern" on MR imaging, which was consistent with the corresponding histologic findings of fibroblastic proliferation interspersed with muscle fascicles. This finding is thought to be similar to early MO, consisting of mainly proliferative fibroblasts and myofibroblasts before the condition progresses.

A rapidly growing painful mass-like intramuscular lesion without a history of trauma can be seen in metastasis, lymphoma, sarcoma, as well as in benign conditions such as infection, proliferative myositis, and MO [4]. In cases of a rapidly growing painful intramuscular mass-like lesion with a "checkerboard-like pattern" of muscle edema on MR imaging and ultrasonography, early MO or proliferative myositis should be considered, which can help avoid unnecessary biopsy or surgery.

In conclusion, we report an unusual case of early myositis ossificans with a "checkerboard-like pattern" without ossification. Although the ossification is not visible, early myositis ossificans should be included in the differential diagnosis of an atraumatic rapidly growing painful intramuscular mass with a pattern of muscle edema on MR imaging and ultrasonography.

Compliance with ethical standards

Conflict of interest The authors declare that there is no actual or potential conflict of interest in relation to this article.

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