A nontraumatic myositis ossificans case of the forearm: Case report and literature review

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Abstract. Myositis ossificans (MO) is a rare, benign ossifying lesion characterized by focal formation of heterotopic bone and cartilage in extraskeletal soft-tissue that most commonly occurs in young adults. In most cases, no causative factor can be identified. The diagnosis of MO is usually based on the patient's history of trauma, clinical signs, on imaging appearance and histological examination. We present a non-traumatic MO case of the forearm in a 40-year-old man with weakness in left finger motion, a decrease in prehension for more than three weeks, without any weight loss, malaise, anorexia or fever. The clinical symptoms and radiological findings can be easily confused with malignant lesions. Treatment is usually conservative but, due to the limited strength and range of motion of the left hand, the tumor was extirpated and the diagnosis of MO was made by biopsy. The patient had no neurological deficits after surgical treatment and was discharged on the fifth day after the surgery in good condition with the recommendation to begin a rehabilitation program.

Introduction

Myositis ossificans (MO) is a rare, benign ossifying lesion characterized by focal formation of heterotopic bone and cartilage in extraskeletal soft-tissue, typically affected areas being the flexor muscles of the arm and the extensor muscles of the thigh (1).

MO most commonly occurs in young adults, with both males and females being affected equally (2). The etiology of MO is variable; in most cases, no causative factor can be identified. However, ~60-70% of cases occur as a result of a repetitive minor mechanical trauma and other possible causative factors include ischemia, inflammation, infections, burns, neuromuscular disorders, hemophilia or drug abuse (1).

The MO localized form is usually a well-circumscribed lesion that frequently complicates hematoma formation of the muscles after sports trauma with contusions. The widespread form of MO occurs in progressive fibrodysplasia ossificans, a rare autosomal dominant mutation disease with ectopic calcifications in several muscles beginning in childhood (3).

The main differential diagnosis of MO is conducted with malignant tumors, such as osteosarcoma, soft-tissue sarcoma (4) or periarticular ossifications that usually occur in a context of central neurological pathologies (5).

The diagnosis of MO is usually based on the patient's history of trauma, clinical symptoms, on radiological findings and histological examination, while laboratory test results are usually normal (6).

Risk factors include male gender, past history of having formed heterotopic bone, hypertrophic osteoarthritis, ankylosing spondylitis, and diffuse idiopathic skeletal hyperostosis (7).

The typical clinical presentation of MO is as a significant inflammatory, rapidly growing, and painful muscular tumor that within a few weeks, becomes a firm and often painful mass which ossifies and becomes painless over 6-12 months.

When X-rays are performed two to three weeks after MO onset and sometimes even later, the ossifications are often missed because standard X-rays do not disclose any anomaly within the early stages of MO (8). A computerized tomography (CT) scan examination is more sensitive than X-ray for ossification diagnosis and may also show a central fatty metaplastic area (9). Magnetic resonance imaging (MRI) is the preferred diagnostic tool in the evaluation of a soft-tissue mass although the final diagnosis is always histological (10). Ultrasonography may be a sensitive imaging modality to early depict the acute phase in MO (10).

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Case report

A 40-year-old man was admitted in the Emergency County Hospital Craiova, Romania, Department of Physical and Rehabilitation Medicine, suffering from weakness in motion of the left fingers with a decrease in prehension for more than three weeks, with no history of a specific acute injury, or exercise-related trauma of the forearm. On physical examination, we palpated a single tumor, slightly tender, hard, not well-circumscribed, poorly mobile, painless lump on the volar side of the left distal forearm. The patient's significant medical history was negative and he reported no weight loss, malaise, anorexia or fever. The usual laboratory findings were normal. Written informed consent was obtained for patient participation and the publication of all associated data and images.

The T2-weighted MRI showed a hyperintense area with surrounding hypointense rim as a well-defined, inhomogeneous soft tissue mass, surrounded by a frame of lower signal intensity, signifying cortical calcification within the muscles of the flexor compartment in the distal and volar part of the left forearm.

The patient underwent a surgical procedure during which the tumor was extirpated completely and the specimen was sent to histopathological examination. The patient had no neurological deficits after surgical treatment and was discharged on the fifth day after the surgery in good condition with the recommendation to begin a rehabilitation program.

Tissue fragments were characterized by adipose tissue and striated muscle fibers dissociated by irregular, infiltrative area proliferating with a zonal pattern; the intermediate zone with osteoblasts including immature osteoid formations, surrounded by myxoid fibrous tissue; areas with fusiform cells with fasciculated growing pattern; richly vascularized areas; peripheral zone characterized of mature cartilage. No necrotic areas were noted.

The histological and pathological findings suggested the diagnosis of MO (Fig. 1A-D). Immunohistochemistry (IHC) tests were recommended. Upon IHC testing, cluster of differentiation (CD)34 was positive in vessels. CD68 was positive in intralesional rare macrophages. Anti-α-smooth muscle actin (α-SMA) antibodies were positive in intralesional area and vessels. Anti-desmin antibodies were positive in striated muscle tissue. The activity of Ki67 proliferative index was positive in 1-3% of cells.

The patient started a program at the Physical Medicine and Rehabilitation Outpatient Clinic. He followed a 30-min exercise program performed five times/week, once daily, which involved active range-of-motion, hand and finger flexion and extension and ball resistance excercises. After 4 weeks of supervised program, he began an unsupervised home exercise program, 15 min, twice a day, after he received detailed instructions concerning the type of exercises, repetitions, intensity, training, rest phases and demonstrations. After 12 weeks of rehabilitative treatment, we assessed the wrist flexion and extension with a goniometer and the Patient-Rated Wrist Evaluation (PRWE) a 15-item questionnaire designed to measure wrist pain and disability in activities of daily living (11). Extension increased to 62.7% and flexion achieved 63.2%. Physical

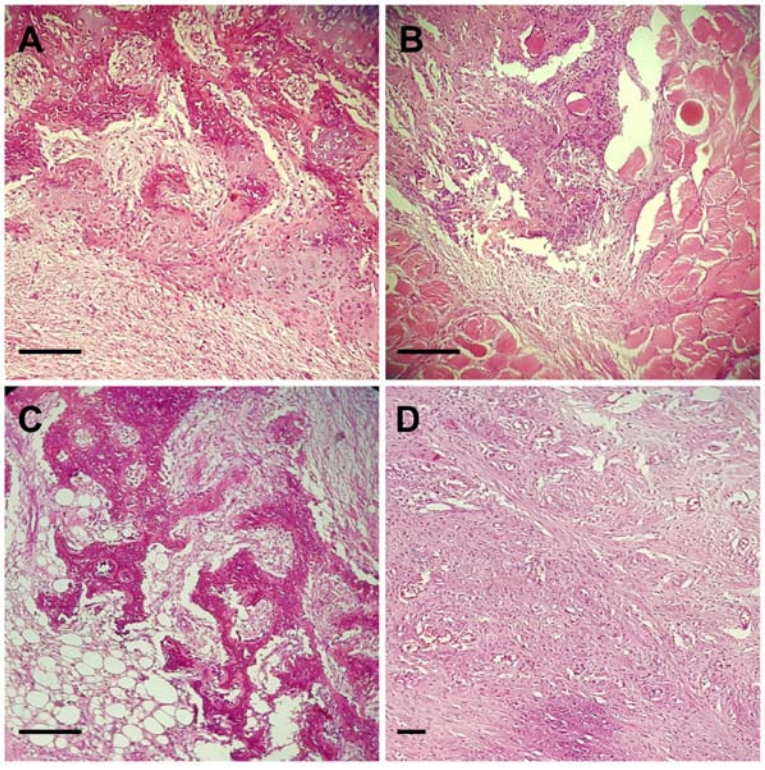

Figure 1. (A-D) Hematoxylin and eosin sections obtain from the tissue show (A) irregular bone and cartilage formation in a background of fasciitis-like, (B) osteoid trabecular entrapped by fragments of skeletal muscle, (C) a central zone of myositis ossificans showing fibroblastic/myofibroblastic proliferation in a (D) zonation pattern across the analyzed sections. Scale bar, 100 μm.

Table I. Literature review of myositis ossificans: localization and etiology.

Author, year (ref.)	Case no.	Age (years)/sex	Etiology	Localization
Goto *et al*, 1998 (12)	1	18/F	Repetitive minor trauma	Tip of the thumb
Onen *et al*, 2019 (13)	1	5/M	Nontrauma	Lumbar region
Jayade *et al*, 2013 (14)	1	25/F	Nontrauma	Medial, lateral pterygoid, and contralateral temporalis muscles
Wei *et al*, 2015 (15)	1	29/F	Long-term nape massage	Serratus anterior
Akahane *et al*, 2015 (16)	1	15/F	Nontrauma	Thenar region
Simmonds *et al*, 2016 (17)	1	5 months/F	Nontrauma, nongenetic mutation	Posterior triangle
Lee *et al*, 2013 (18)	1	26/F	Acupuncture	Paraspinal muscles of the neck
Raudenbush *et al*, 2017 (19)	1	30/M	Upper cervical spine fracture	Longus coli muscle
Abdallah *et al*, 2014 (20)	1	31/M	Nontrauma	Lumbar spine
Bultheel *et al*, 2016 (21)	1	21/M	Nontrauma	Superior anterolateral thigh
Yunus *et al*, 2016 (22)	1	36/F	Nontrauma	Hip
Dubuisson *et al*, 2019 (23)	1	5 years, 6 months/M	Nontrauma	Neck region

F, female; M, male.

therapy also increased hand function with better results to 12-week PRWE.

Discussion

In the event a patient has no history of traumatic injury, it is difficult to diagnose MO. In some cases, we must ask the patient concerning such minor injuries such as strenuous physical activity, heavy manual labor or weight lifting.

Most commonly MO affects the largest skeletal muscles of the body, typically after a trauma, but the exact pathophysiology is still poorly understand. We searched various MO cases of different localizations and different traumatic and nontraumatic etiology reported in the literature (Table I).

In 1998, Goto *et al* described a case of MO in a 18-year-old woman in the tip of the left thumb after repetitive minor trauma. The lesion arose in the subcutaneous fatty tissue in the distal portion of the thumb and had a typical zonal pattern (12). A 5-year-old pediatric patient who developed scoliosis associated with nontraumatic MO in the lumbar region was described by Onen *et al* (13). There has been no report of scoliosis associated with myositis ossificans. Jayade *et al* (14) described a rare case of MO in medial and lateral pterygoid and contralateral temporalis muscles in a 25-year-old woman without any obvious etiology, with no history of trauma, tooth extraction, or infection.

In 2015, Wei *et al* (15) presented the case of a 29-year-old woman with a rare form of MO of the serratus anterior that developed due to long-term aggressive nape massage. The symptoms disappeared after surgery. In addition, in 2015, the case of a 15-year-old Japanese girl with a 2-month history of a painful mass in the right thenar region without previous trauma was presented by Akahane *et al*. The diagnosis of MO was made on incisional biopsy (16).

In 2016, Simmonds *et al* presented a case of a 5-month-old infant with a posterior neck mass suspicious for neoplasia, which was treated with surgical resection and found to be a non-traumatic, non-genetic form of MO (17). In 2013, Lee *et al* (18) reported a case of a 26-year-old woman with MO in the paraspinal muscle of the neck after acupuncture. The patient was conservatively treated through rest and analgesics and the neck pain and swelling improved following several months.

Raudenbush *et al* (19) reported a case in 2017 of a 30-year-old male with upper cervical spine fracture occurring due to high-energy trauma that resulted in MO of the longus coli muscle. The patient was treated non-operatively for neck rotation and MO with gradual improvement of symptoms. Abdallah *et al* (20) presented the rare case of a 31-year-old Turkish man with MO not associated with trauma, with severe low back pain and restriction of low back motion. A biopsy was necessary to confirm diagnosis and the mass was surgically excised from the patient.

An atypical presentation of MO in the superior anterolateral thigh of a 21-year-old male is presented by Bultheel *et al* (21) in 2016. This case demonstrates that the diagnosis of MO can be more challenging in the absence of a history of trauma. In 2016, Yunus *et al* (22) presented a hip case of MO without any trauma occurring in a 36-year-old female. Nontraumatic MO is very rare in the literature. Dubuisson *et al* (23) in 2019 described a case of a 5 years and 6 months old boy with a cervical tumor causing torticollis and high suspicion of malignancy. The lesion was completely resected and the biopsy established the diagnosis of MO.

Involvement of the forearm is very rare and only a few cases have been reported to date. Say *et al* reported a rare case of MO on the forearm in a 10-year-old girl (24) and Grebić *et al* reported a case of MO in the forearm of a 48-year-old woman presenting clinically as a mesenchymal tumor (25).

Early in the disease, the lesion is soft and painful, and within a few weeks, the lesion becomes firm; and over 12 months it ossifies and becomes painless. Significant functional deficits result in only 10-20% of patients (26).

MO passes through three characteristic phases. The acute phase (first week) is when the proliferation is composed of mesenchymal cells secreting a myxoid matrix, as well as fibroblasts exhibiting numerous mitoses, which gives the mass a pseudo-fibrosarcomatous appearance. The subacute phase (next two weeks) is when histologically fibroblasts differentiate into osteoblasts and secrete an osteoid matrix at the periphery of the initial myxoid zone, giving it a pseudo-osteosarcomatous appearance. Finally, the maturation phase (2-5 weeks) is when a histological diagnosis can accurately be carried out (27).

Due to the presence of bone formation as well as a similar epidemiology, osteosarcoma needs to be excluded. It is very important to identify the early stage of MO using imaging. However, early in the disease course, radiographs are often negative and a biopsy conducted at the early stage of MO may lead to a wrong diagnosis of sarcoma. On the other hand, when biopsy is delayed, a true sarcoma may be missed. Computerized axial tomography optimally identifies the typical patterns of this disease, including the separation of the mass from the adjacent cortex and the decreased attenuation of the center of the mass (9).

MRI is the elected investigation for evaluating soft-tissue lesions with the classic finding for MO, a peripheral rim enhancement that correlates with calcification and ossification (28). MO can disappear spontaneously, the treatment is usually reserved for symptomatic lesions: Rest, ice, compression, nonsteroidal anti-inflammatory drug (NSAID) therapy could be initiated leading to clinical improvement and concomitant decrease of the soft tissue swelling. The specialty literature recognized that NSAIDs may stop the evolutionary process of MO (29).

Surgical excision is generally reserved for symptomatic MO lesions. However, since recurrence has been reported, excision with clear resection margins is recommended (30). When symptoms are not associated with trauma, the diagnosis of MO is challenging. The MRI findings may suggest the mesenchymal tumor like malignant fibrous histiocytoma.

Finally, diagnosis is always established by histopathological examination. It may be difficult with histological evidence alone to differentiate an MO from a sarcoma; therefore, correlation of the clinical and radiological findings is important in such cases. There is no need for further therapy once the diagnosis of MO has been established by excision. MO is a rare clinical entity and understanding its etiology and pathophysiology can save the patient from the anxiety of a suspected neoplasm.

In conclusion, particularities of our case report is the diagnosis of MO in middle aged patients, which is very rare, as MO commonly occurs in young males. Our patient had no history of acute injury or repetitive minor trauma of the forearm, thus the aetiology still remains unclear. In addition, involvement of the forearm muscles is rare. We found in our literature search only a few cases reported. Treatment is usually conservative but, due to the limited strength and range of motion of the left hand, the tumor was extirpated and the diagnosis of MO was made by biopsy. In future research, the molecular mechanisms of this rare disease must be discovered and gene therapy may be used in the early stages as a treatment strategy.

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Availability of data and materials

Further information regarding the case and the review may be requested from the corresponding author upon reasonable request.

Authors' contributions

DR performed the surgical procedure. SP, VP, RRM, RP, and DM carried out the patient investigation and SP, VP, RP, and MB data curation. SP, VP, DR, and DM carried out the writing and original draft preparation. VP, RRM, RP, DM and SP performed the literature data review and SP and VP finally reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

Ethics approval and consent to participate

The case report was approved by the local institutional Ethics Committee of the University of Medicine and Pharmacy of Craiova.

Patient consent for publication

Written informed consent was obtained for patient participation and the publication of all associated data and images.

Competing interests

The authors declare that they have no competing interests.

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