CASE REPORT

Myositis ossificans: the mimicker

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SUMMARY

A 14-year-old boy presented with upper backache and a painful swelling in the right paraspinal region for 7 days. He had no history of trauma. MRI showed a non-specific ill-defined heterogeneous lesion, which showed intense postcontrast enhancement. Ultrasonogram showed a peripheral sheet of calcification around the lesion. A CT scan showed a faint rim of calcification, which increased in thickness over weeks, confirming the diagnosis as myositis ossificans. We present our approach to the case and also review the imaging features of different stages of the disease process and their differentials.

BACKGROUND

Myositis ossificans (MO) in its early stage has a non-specific imaging appearance and can mimic a number of pathologies. When it presents as a soft tissue mass, MRI is the initial line of investigation. But MRI has poor sensitivity towards calcification, which is the predominant feature of MO. Thus the MRI findings can be misleading. But an ultrasonogram can readily depict the peripheral calcifications, even before they appear on CT scan or MRI and can prove beneficial in the management of the patient.

CASE PRESENTATION

A 14-year-old male patient of Indian origin presented with upper back pain for 7 days. The back pain was gradual in onset and progressive, it was dull aching, continuous and aggravated on lying down and getting up. He was a school-going kid and played the usual amount of sports. He had no history of trauma. He had no history of exposure to tuberculosis or a history of loss of weight. On examination he had a firm swelling and associated tenderness in the right paraspinal region at the level of T1 vertebra. There was no redness or warmth over the region. The general examination was otherwise unremarkable. He had no focal neurological deficit or lymphadenopathy.

INVESTIGATIONS

Biochemical and haematological investigations were normal. An initial radiograph of the dorsolumbar spine showed mild scoliosis of the lower thoracic vertebrae with convexity to left (figure 1).

MRI showed a bilobed lesion, adjacent to the right transverse process of L1 vertebra within the right erector spinae muscle measuring $2.5 \times 2.0 \times 1.5$ cm. The lesion was isointense to the muscle in T1-weighted images (T1-WI; figure 2C). In T2-weighted images (T2-WI) and short tau inversion recovery (STIR) images, the central part of the lesion was heterogeneously hyperintense

with a thin hypointense rim at the periphery (figure 2A, B). The lesion showed intense, almost homogenous enhancement with enhancement of the central core of the lesion (figure 2D). There was extensive oedema along the muscle fibres of right erector spinae, which showed enhancement on postcontrast images. The adjacent L1 vertebra showed no changes. We suspected that the thin hypointense rim in T2-WI could possibly be due to calcification.

On the ultrasonography, the lesion was heterogeneously hypoechoic with a peripheral interrupted sheet of hyperechoic foci with acoustic shadowing, suggestive of calcification (figure 3). The lesion showed internal vascularity on a power Doppler examination.

With the suspicion of early-stage MO, limited CT sections of the involved region were taken. A CT scan showed the bilobed lesion with a thin rim-like calcification of the anterosuperior component of the lesion (figure 4A) and faint hyperdensities within the posteroinferior component (figure 4B). On account of the imaging findings, a provisional diagnosis of MO was given.

DIFFERENTIAL DIAGNOSIS

MO in its early stage can mimic an intramuscular abscess, a haematoma, focal myositis and osteomyelitis. A history of trauma is usually noted in MO

Figure 1 Anteroposterior radiograph of the dorsolumbar spine shows mild scoliosis with convexity to the left side (white arrow).

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Figure 2 MRI of the patient. T2-weighted axial image (A) and short tau inversion recovery coronal image (B) show that the central part of the lesion (asterisk) is heterogeneously hyperintense with a thin hypointense rim at the periphery (black arrows) and oedema along the adjacent muscle fibres (white arrows). Precontrast T1-weighted axial image (C) showing the lesion (marked with asterisk) to be isointense to the muscles, which on postcontrast T1-weighted image (D) showing intense, almost homogenous enhancement with enhancement of the central core of the lesion (asterisk). Enhancement of the oedema along the muscle fibres is also seen (white arrows).

and a haematoma. Intramuscular abscess, focal myositis and osteomyelitis present with fever and a very tender swelling. An increase in erythrocyte sedimentation rate or C reactive protein may be observed in all the lesions. In the absence of trauma and fever (as our patient presented), when imaging is carried out, MO can mimic a soft tissue sarcoma. MO, focal myositis, osteomyelitis and haematoma are managed conservatively with varying drugs for each, intramuscular abscess needs to be drained and soft tissue sarcoma needs to be biopsied. Owing to varied management paths, differentiating MO from other lesions via imaging is paramount.

Figure 3 Ultrasonogram showing the lesion as heterogeneously hypoechoic with a peripheral interrupted sheet of hyperechoic foci (black arrows) with acoustic shadowing, suggestive of calcification. The lesion showed internal vascularity (asterisk) on colour Doppler examination.

In focal myositis, an ultrasonogram shows a prominent muscle with an ill-defined lesion, which is isoechoic to hypoechoic with the muscle and shows increased vascularity. MRI shows a mass-like lesion with heterogeneous high signal intensity in T2-WI and intense postcontrast enhancement.¹ It regresses on follow-up scans without calcifying. In case of an evolving intramuscular abscess, an ultrasonogram shows an irregular hypoechoic or anechoic lesion with no internal vascularity. A CT scan shows a heterogeneous hypodense lesion before liquefaction and a hypodense lesion, postliquefaction. In MRI, evolving abscess will be heterogeneously hyperintense in T2-WI and liquefied abscess will be homogeneously hyperintense in T2-WI and only wall enhancement is seen in postcontrast study.¹ In case of an intramuscular haematoma, hyperechoic contents are seen in ultrasonogram and it appears hyperdense in CT. In MRI, it appears hyperintense on T1-WI because of the methaemoglobin,¹ which shows a variable signal on T2-WI and shows no postcontrast enhancement. Soft tissue sarcomas are usually large, irregular, heterogeneous masses.² They are hypoechoic with internal vascularity on an ultrasonogram. In MRI, they are isointense to hypointense in T1-WI and heterogeneously hypointense to hyperintense in T2-WI, depending on the fibrous content. Postcontrast, sarcomas show moderate-to-intense heterogeneous enhancement and may have central necrotic regions. Bony invasion or erosion is seen in sarcomas.²

In osteomyelitis, an X-ray will reveal a normal bone or may show lytic focus with surrounding sclerosis, non-specific soft tissue prominence, mild periosteal new bone formation and when left untreated, a layered periosteal new bone formation is seen.³ Ultrasonogram will show soft tissue swelling and oedema in response to the infection, an increase in vascularity may be seen and if the focus is near a joint, joint effusion may be seen. MRI will show soft tissue and bone marrow oedema and inhomogeneous signals in bone marrow. A triple phase bone scan and an Indium labelled white cell count (WCC) scan will help in resolving the clinical dilemma. A marked increase in uptake in

Figure 4 CT images in bone window (acquired on the same day of MRI examination) show rim-like calcification of the anterosuperior component (white arrows in A) of the lesion and faint hyperdensities within the posteroinferior component of the lesion (white arrows in B).

both bone scan and WCC intake is noted in osteomyelitis, while MO will show an increased bone scan uptake without corresponding increase in the WCC uptake.

TREATMENT

A biopsy of the lesion was not carried out as it could lead to confusion (explained in Discussion section). The patient was treated conservatively with indomethacin and the pain subsided.

OUTCOME AND FOLLOW-UP

A follow-up CT scan on the 12th day of admission showed that the peripheral rim of calcification was near complete and was increasing in thickness (figure 5A–D). On account of the rapid peripheral pattern of mineralisation, the diagnosis of MO was confirmed.

DISCUSSION

MO is a benign, self-limiting, heterotrophic ossification predominantly seen in the muscles of the extremities. It may occur at any age, but higher incidence is noted in the second and third decades of life.⁴ The exact aetiology remains unclear. A history of prior trauma is reported in around 60–75% of patients.⁵ Thus in nearly one-fourth of the patients, MO occurs without previous trauma. Following contusions, the incidence of MO occurring is 9%.⁶ About 80% of cases are reported to arise from the extremities (quadriceps femoris and brachialis anterior).⁷ MO in paraspinal muscles is very rare.⁸

Clinically it presents as a rapidly growing and painful muscular mass. Fever may be present. If it occurs close to a joint, restriction of movements is seen. In the early stage of the disease process, due to the inflammatory response, C reactive protein may be elevated.

Figure 5 Axial CT images (A and B) in bone window (taken 12 days after the first scan) showing a complete rim of peripheral calcification, which shows increased thickness when compared with the previous CT in both the components of the lesion. Sagittal (C) and coronal (D) reconstructed images show the bilobed nature of the lesion with an anterosuperior (black arrows) and a posteroinferior component (white arrows).

Pathology

Pathologically, MO passes through three stages - early, intermediate and late.⁹ In the early stage, there is a central core of myxoid matrix and fibroblasts and a minor peripheral osteoid component. In the intermediate stage, the fibroblasts differentiate into osteoblasts and begin secreting an osteoid matrix, beginning from the periphery. Thus a shell of lamellar bone forms around the lesion and progresses centripetally. In the late stage, mature lamellar bone is seen. It takes about 7–8 weeks for a lesion to attain maturity. After maturation, the lesion may regress in size and in about 30% of patients; it spontaneously resolves.¹⁰

A premature biopsy carried out during the early or intermediate stage of the disease has confusing findings and high false-positive rates for the misdiagnosis of a sarcomatous tumour,¹¹ and hence should be avoided.

Early-stage lesions are found in patients with 3–6 weeks of symptoms, intermediate-stage lesions in patients with 6–8 weeks of symptoms and late lesions in patients with 8 weeks of symptoms.⁹

Imaging findings

Radiology plays a central role in the diagnosis of MO. The imaging findings of the lesion evolve in parallel with the three stages. In the early stage, X-ray will be normal or may show mild soft tissue prominence. An ultrasonography shows a hypoechoic lesion with a peripheral hyperechoic sheet with acoustic shadowing (suggestive of calcification) and vascularity within the lesion.¹² A CT scan shows an enlarged muscle with an ill-defined lesion, with or without faint calcification at the periphery of the lesion. In MRI, the lesion shows intermediate-to-high signal intensity in T2-WI with or without a hypointense rim, isointensity to muscle in T1-WI and avid post-contrast enhancement.⁵ Perilesional oedema is seen along the muscle fibres. Thus early calcification is seen as a reflective sheet in an ultrasonogram even before it appears on CT or MRI. The internal vascularity in an ultrasonogram and complete enhancement in the MRI rules out an abscess or haematoma.

In the intermediate stage, an X-ray and CT show a well-defined lesion with a thick peripheral calcific rim. A typical zonal phenomenon is noted in other imaging. Ultrasonography shows three concentric zones.¹³ The peripheral zone is hypoechoic, corresponding with the perilesional hyperaemia. The second zone is hyperechoic due to the calcification and the innermost zone is hypoechoic, corresponding to the central stromal content. MRI shows a well-defined hypointense rim of varying thickness in T1-WI and T2-WI (suggestive of calcification).¹⁴ The central part of the lesion is isointense to hypointense to muscle in T1-WI and is inhomogeneous and of variable signal intensity in T2-WI. During this stage, if the lesions are around the joint, the differentials are synovial sarcoma, rhabdomyosarcoma and calcific tendonitis. But, the calcifications in synovial sarcoma, rhabdomyosarcoma will be central and interrupted, while in MO, they are peripheral and continuous.¹⁵ Bony invasion or erosion is seen in sarcomas. Calcific tendonitis presents as a poorly defined soft-tissue calcification without an associated mass. The calcification tapers away from the bone mimicking a 'comet tail' appearance.¹⁶

In the late stage, an X-ray and CT show a fully calcified lesion with trabecular bone formation. Sometimes, it may merge with the cortex of the adjacent bone. On MRI, the lesion is mostly hypointense in all sequences owing to the calcification. The centre of the lesion may show areas with intensity similar

to that of normal bone marrow.¹⁴ Perilesional oedema is absent. During this stage, differential diagnoses are extraskelatal and paraosteal osteosarcomas. The calcification starts peripherally and progresses centripetally in MO; while in osteosarcomas, calcification is dense, initially central and progresses centrifugally.²

Treatment

Treatment is mostly conservative as many of the lesions regress in size and some may disappear spontaneously. Non-selective non-steroidal anti-inflammatory drugs like indomethacin may stop the evolutionary process of MO.¹⁷ Surgical resection is suggested if there is restriction of motion, pressure effect on nerves or blood vessels, pain and limitation of athletic, occupational or daily activities.¹⁸ Surgery should only be carried out after a lesion matures to avoid recurrence. Recently, extracorporeal shockwave therapy has proved effective in treating MO.¹⁹

Learning points

- ▶ Myositis ossificans (MO) can occur in the absence of trauma and may mimic other benign and malignant pathology during its early stage.
- ▶ MRI can be misleading, but a thin peripheral hypointense rim in T2-weighted images should raise the suspicion of MO in the appropriate clinical setting.
- ▶ An ultrasonogram is more sensitive than MRI or CT in detection of early peripheral calcifications in MO.
- ▶ Biopsy should be avoided to prevent misdiagnosis of a sarcomatous tumour.
- ▶ Rapidly progressive calcification on follow-up imaging should confirm the diagnosis of MO.

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REFERENCES

- 1 May DA, Disler DG, Jones EA, *et al.* Abnormal signal intensity in skeletal muscle at MR imaging: patterns, pearls, and pitfalls. *Radiographics* 2000;20(Spec No): S295–315.
- 2 Mirra JM. Osseous soft tumors. In: Mirra JM, Picci P, Gold RH, eds. *Bone tumors: clinical, radiologic and pathologic correlations*. London: Lea and Febiger, 1989:1549–86.
- 3 Wilson DJ, Berendt AR. Bone and soft tissue infection. In: Adam A, Dixon AK, Grainger RG, Allison D. *Grainger & Allison's diagnostic radiology: a textbook of medical imaging*. 5th edn. New York: Churchill Livingstone, 2008:1153–69. ISBN-10:0443101639.
- 4 Messina M, Volterrani L, Molinaro F, *et al.* Myositis ossificans in children: description of a clinical case with a rare localization. *Minerva Pediatr* 2006;58:69–72.
- 5 Parikh J, Hyare H, Saifuddin A. The imaging features of post-traumatic myositis ossificans, with emphasis on MRI. *Clin Radiol* 2002;57:1058–66.
- 6 Ryan JB, Wheeler JH, Hopkinson WJ, *et al.* Quadriceps contusions. West point update. *Am J Sports Med* 1991;19:299–304.
- 7 Nuovo MA, Norman A, Chumas J, *et al.* Myositis ossificans with atypical clinical, radiographic, or pathologic findings: a review of 23 cases. *Skeletal Radiol* 1992;21:87–101.
- 8 Baysal T, Baysal O, Sarac K, *et al.* Cervical myositis ossificans traumatica: a rare location. *Eur Radiol* 1999;9:662–4.

- 9 Kransdorf MJ, Meis JM, Jelinek JS. Myositis ossificans: MR appearance with radiologic-pathologic correlation. *Am J Roentgenol* 1991;157:1243–8.
- 10 Ogilvie-Harris DJ, Fornasier VL. Pseudomalignant myositis ossificans: heterotopic new-bone formation without a history of trauma. *J Bone Joint Surg Am* 1980;62:1274–83.
- 11 Mokhtari M, Kumar PV, Rezazadeh S. Confusing cytological findings in myositis ossificans. *Acta Cytol* 2012;56:565–70.
- 12 Gindele A, Schwamborn D, Tsironis K, et al. Myositis ossificans traumatica in young children: report of three cases and review of the literature. *Pediatr Radiol* 2000;30:451–9.
- 13 Lacout A, Jarraya M, Marcy PY, et al. Myositis ossificans imaging: keys to successful diagnosis. *Indian J Radiol Imaging* 2012;22:35–9.
- 14 De Smet AA, Norris MA, Fisher DR. Magnetic resonance imaging of myositis ossificans: analysis of seven cases. *Skeletal Radiol* 1992;21:503–7.
- 15 Goldman AB. Myositis ossificans circumscripta: a benign lesion with a malignant differential diagnosis. *AJR Am J Roentgenol* 1976;126:32–40.
- 16 Amendola MA, Glazer GM, Agha FP, et al. Myositis ossificans circumscripta: computed tomographic diagnosis. *Radiology* 1983;149:775–9.
- 17 Fijn R, Koorevaar RT, Brouwers JR. Prevention of heterotopic ossification after total hip replacement with NSAIDs. *Pharm World Sci* 2003;25:138–45.
- 18 Kir MC, Ozdemir MT. Myositis ossificans around shoulder following military training programme. *Indian J Orthop* 2011;45:573–5.
- 19 Buselli P, Coco V, Notarnicola A, et al. Shock waves in the treatment of post-traumatic myositis ossificans. *Ultrasound Med Biol* 2010;36:397–409.

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