Imaging of musculoskeletal complications of hematologic diseases

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Learning objectives

The objectives of this study are to:

1. - Analyse the radiological findings of musculoskeletal complications that can occur in patients with haematologic diseases using Computed Tomography (CT) and magnetic resonance imaging (MRI).

2. - Differentiate musculoskeletal complications from tumor involvement attributed to the haematologic disease, for the election the most appropriate treatment.

Background

Treatment with chemotherapy and / or radiotherapy for haematological disorders may cause complications owing to drug toxicity and / or immunosuppression, including infection by opportunistic pathogens, septic arthritis, osteonecrosis, osteoporosis, fractures and avascular necrosis.

It is important to select the most appropriate imaging technique to make the diagnosis and give early treatment in each case.

In this study we include the following diagnoses: acute myeloid leukaemia (AML), non-Hodgkin lymphoma (NHL), multiple myeloma (MM), myelodysplastic syndrome (MDS), monoclonal gammopathy and pancytopenia, collected in the database of our Haematology Service, in the period between 2006 and 2011, studied with CT and / or MRI.

Overall, we review the history of 35 patients, discarding 5 of them for demonstrating musculoskeletal involvement by their underlying disease. Of the remainder:

15% had cellulitis,

25% muscle abscesses and / or pyomyositis,

15% osteomyelitis,

5% spondylodiscitis,

20% avascular necrosis and
20% pathologic fractures.

All cases have been followed clinically and/or confirmed by microbiology or pathology service.

The radiological findings were:

**CELLULITIS:**

It is an acute infection of the dermis and subcutaneous tissue. The CT performs the differential diagnosis between cellulitis and cellulitis associated with deep tissue infection. Microbiological analysis confirmed the presence of *Staphylococcus aureus* (*S. aureus*) in our cases. Fig. 1 on page 4 and Fig. 2 on page 5.

**ABSCESSES:**

It is a common disease in immunocompromised patients. The CT contrast study delineates the collections with typical ring enhancement, easily distinguishable from cellulitis or fasciitis. The MRI defines whether there is further extension of this disease and contributes to the choice of treatment with antibiotics or percutaneous drainage. Fig. 3 on page 7 and Fig. 4 on page 7.

**PYOMYOSITIS:**

The most frequently isolated infectious agent is *S. aureus*. The muscle affection is the most common, although one of our cases presented as polymyositis. The most common locations are the quadriceps muscle, followed by the gluteus, iliopsoas, being uncommon in upper extremities.

CT findings show a decreased attenuation of the affected muscle with effacement of fat planes, and may be associated with intramuscular collections or abscesses (Fig. 4 on page 7). This condition requires surgery, as torpid evolution of polymyositis can lead to compartment syndrome, osteomyelitis and / or septic shock.

As well as in abscesses, MRI delimits whether there is further extension of this pathology. Fig. 5 on page 8 and Fig. 6 on page 9.
OSTEOMYELITIS, SPONDYLODISCITIS:

In immunocompromised patients, osteomyelitis occurs by haematogenous invasion. Bone disease is most commonly found in tibia, wrist, femur, ribs and thoracolumbar spine.

The most frequently isolated pathogen is also *S. aureus*.

MRI is the imaging technique of choice for early diagnosis of this pathology. Complications include abscesses, arthritis, fractures or fistulas. Fig. 7 on page 10, Fig. 8 on page 11 and Fig. 9 on page 12.

AVASCULAR NECROSIS AND BONE INFARCTS:

This condition mainly appears as a consequence of therapy with corticosteroids and other drugs used in the treatment of haematologic diseases. The most common site is the femoral head, frequently bilateral, followed by the humeral head. If there is a clinical suspicion of avascular necrosis, MRI is the technique of choice. This technique early diagnoses this pathology and its extension, which may allow a conservative treatment instead of a surgical one.

When the lesion is located in the diaphysis of long bones, it is radiologically defined as a bone infarct. Fig. 10 on page 13, Fig. 11 on page 14, Fig. 12 on page 15, Fig. 13 on page 16 and Fig. 14 on page 16.

PATHOLOGIC FRACTURES:

Therapy with corticosteroids and other drugs (eg methotrexate) are the most common cause of osteoporosis and its complications, such as insufficiency fractures. Fig. 15 on page 17, Fig. 16 on page 18 and Fig. 17 on page 19.

Images for this section:
Fig. 1: AML patient diagnosed with large right side facial oedema and erythema. Cervical CT, axial view with intravenous contrast. Initial CT (A, B) and control CT four days later (C, D). A and B: Increased thickness and attenuation of the right facial fat, effacement of fat planes between the masseter muscle and parotid. Diagnosis: right facial cellulitis. C and D: Progression of signs of cellulitis with posterior cervical extension.
**Fig. 2:** NHL diagnosed patient. CT of abdomen, pelvis and lower limbs. A, B, C and D, axial: trabeculation and thickening of the subcutaneous tissue at the root of the right leg and bilateral inguinal lymphadenopathy, consistent with cellulitis.

![Images of CT scans](image)

**Fig. 3:** 21 year old male. Pain and loss of function of the left thigh. Aplasia by azathioprine. MRI of the lower limbs. A: sagittal STIR sequence. B: Axial T1 FAT SAT Gado. C: Coronal T1 Gadolinium. D: Sagittal T1 FAT SAT Gado. MRI showing a hypersignal in the left vastus intermedius, with diffuse enhancement after injection of contrast, delimiting a central zone of absence of enhancement: inflammatory changes regarding pyomyositis and intramuscular abscess.
**Fig. 4:** 82 year old patient with AML. *Clostridium septicum* myositis. CT angiography of the lower limbs, axial view. A, B, C, D, E and F: increased size of all the muscles of the left thigh, with increased attenuation in the fat planes. Hypodense collections with peripheral enhancing. Subcutaneous oedema of the left leg. Diagnosis: pyomyositis with multiple abscesses.
Fig. 5: Patient in complete AML remission after chemotherapy. MRI. A: Coronal T1. B: Coronal STIR. C: Axial T1 FAT SAT Gado. D: Coronal T1 Gado. E: Sagittal T1 Gado. Asymmetry of the left gluteal muscles, identifying hypersignal in B. with diffuse enhancement after administration of contrast and some areas of absence of enhancement compatible with pyomyositis and microabscess.
Fig. 6: 68 year old patient with aplastic anemia after chemotherapy for acute leukemia. Pain in left iliac blade. Lumbosacral spine MRI. A and B: sagittal and axial T1. C and D: sagittal and axial Gado. Marked hyposignal in bone marrow in all sequences because of myelofibrosis. Diffuse enhancement in left psoas after contrast administration, with areas of no-enhancement compatible with microabscesses.
Fig. 8: 64 year old woman diagnosed with MM in 2004. Treated with chemotherapy and transplant. Total body MRI. A: Coronal STIR. B and C: T1 and STIR whole body, showing hyposignal in iliac blade and right sacral wing, in relation to osteomyelitis.
Fig. 9: Patient with AML secondary to NHL. Left shoulder surgery for chronic osteomyelitis of the humerus. MRI of left shoulder. A and B: axial T1 FAT SAT Gado. C and D: Coronal. Osteomyelitis with large abscess in the marrow of the metaphyseal-diaphyseal region of the proximal humerus, with cortical destruction and fistulization to soft tissues, with axillary abscess.
Fig. 10: 47 years old patient with MDS treated with corticosteroid therapy. Acute inflammatory hip pain, with normal radiography. MRI. A, B and C: axial T1, STIR FAT SAT and T1 Gado. D and E: Coronal STIR and T1 FAT SAT Gado. Subchondral fracture on the upper surface of the right femoral head, related to avascular necrosis. Oedema in the adjacent muscles. Double halo sign in B. in left femoral head is identified, which also corresponds to avascular necrosis.
**Fig. 11:** A 62 years with MM. MRI. A, B and C: Coronal T1, STIR and T1 FAT SAT Gado. D and E: T1 and axial T1 FAT SAT Gado. Marked hyposignal affecting iliac blade and left femoral head and neck. Intense gadolinium enhancement. Subchondral fracture in the left femoral head relative to irreversible avascular necrosis.
**Fig. 12:** Patient with NHL and previous corticosteroid treatment. Bilateral hip pain. MRI. A and B: axial T1. C and D: axial STIR. Double-halo sign in both femoral heads and right greater trochanter compatible with avascular necrosis.

**Fig. 13:** Patient of Fig 12. Right shoulder MRI. A: Axial T1. B: Coronal T1. C: Coronal T2 FAT SAT. Avascular necrosis.
Fig. 14: Same patient as Fig 12 and 13. Right knee MRI. A: Axial PD FAT SAT. B: Sagittal PD. C: Coronal PD FAT SAT. D: Coronal T1. Small nodule of fat signal in the external tibial condyle, surrounded by hypointense rim on T1, compatible with bone infarct.
Fig. 15: 56 years old woman with MM. Low back pain. MRI. A: Sagittal T1. B: Sagittal STIR. C: Sagittal T1 FAT SAT Gado. Decrease in height of the vertebral bodies T8, T11, L1, L2, L3 and L4. Small hypointense nodule in L1, bright in STIR sequence with contrast enhancement, compatible with tumor infiltration of MM. The remaining vertebral bodies are compatible with stress fracture.
Fig. 16: Acute low back pain in patient with monoclonal gammopathy. MRI. A: Sagittal T2 FAT SAT. B: Sagittal T1. C: Sagittal T1 FAT SAT Gado. MRI shows L1 vertebral body height has decreased. Low signal in T1, high signal in STIR, with a bandlike fracture line with surrounding bone oedema, in relation to acute fracture of osteoporotic origin. Chronic fracture in L4.
Fig. 17: NHL treated with chemotherapy. A: Axial pelvis CT. B: MRI axial T1. C: MRI axial T1 FAT SAT Gado. The sacrum shows a low signal vertical linear image surrounded by a hypointense area in T1 and bright in STIR compatible with fracture and bone marrow oedema.
Imaging findings OR Procedure details

A 1.5 tesla MRI is used to perform exams.

Conclusion

Most frequent radiological findings of musculoskeletal complications include: cellulitis, muscle abscesses, pyomyositis, osteomyelitis, avascular necrosis and pathological fractures.

The study of these complications with CT and MRI differentiates them from tumoural pathology, which is essential in continuing or modifying the patient's treatment.

References


Personal Information