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Clinical vignette

MRI and ^{18}F-FDG-PET/CT in a rare case of early (precursor) B-lymphoblastic leukaemia with bone involvement as initial manifestation

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Abstract

A 4-year old girl presenting gait difficulty was referred for spine X-ray and Magnetic Resonance Imaging (MRI). MRI showed several diffuse hypointense signals in sacral and lumbar vertebrae. In order to exclude a possible lymphoproliferative disease a 18-fluorodeoxyglucose positron emission tomography/computed tomography (^{18}F-FDG-PET/CT) was requested. The PET/CT scan confirmed the MRI findings and demonstrated additional findings in the sternum. Therefore, a bone marrow biopsy was performed and a diagnosis of acute lymphoblastic leukaemia — early B type was made.

KEY words: 18F-FDG-PET/CT, magnetic resonance imaging, acute lymphoblastic leukemia, AIEOP-BFM ALL, pediatrics, bone

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Background

Acute lymphoblastic leukemia (ALL) is the most common malignant neoplasm in childhood [1]. The common sites of primary involvement or recurrence are the testicles (2%), central nervous system (CNS) (5–11%), ovaries, breast, eye, skin, and lymph nodes [1–3]. There are limited data in literature regarding ALL with bone as primary involvement in pediatric patients, assessed by ^{18}F-FDG PET/CT [4].

MRI is usually performed in selected districts in patients with ALL on the basis of the clinical suspicion [5]; PET/CT is not routinely used. We aim to show the clinical utility of ^{18}F-FDG PET/CT in detecting extra-haematological sites of disease in a patient with diffuse bone involvement as initial manifestation of ALL.

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Case report

In October 2012, after an accidental fall, the 4-year old girl presented difficulty in walking. A month later, the girl fell again and presented fever, which was treated with paracetamol. Difficulty in walking was still present, without apparent pain or any other symptoms.

In January 2013, an X-ray of the inferior limbs was negative (Figure 1). Thus, the girl received a neuropsychiatric evaluation, which ruled out any possible neurologic disease.

Then the paediatrician requested a blood sample examination, which showed an increase of the inflammation markers: VES 83 mm/h (v.n. < 29), PCR 146.7 mg/L (< 10); white blood cells were within the normal range (5.8×10^3/uL). As a consequence, a suspicion of multifocal chronic osteomyelitis of the lower limbs rose. In consideration of the blood test results, a thoracic X-ray was performed and demonstrated a basal parenchymal consolidation in the left lung. Therefore, the girl was transferred to the Department of Infectious Diseases. During the hospitalization, the patient received an empiric antibiotic therapy (Ceftriaxone, Amoxicillina e Clavulanic Acid) with resolution of the pulmonary finding.

In the following days, due to the onset of low back pain, the girl underwent a MRI of the brain and spine, which showed several diffuse hypointensity within the bone marrow, in sacral and lumbar metamera, and a hiperintensity signal in S1 in the T2- weighted

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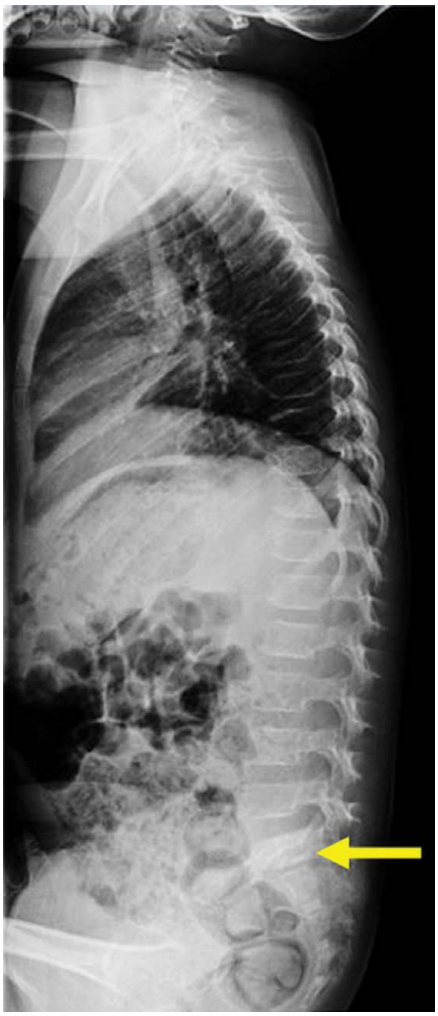

Figure 1. Spine X-ray images in sagittal view of a 4-year old girl, with difficulty in walking, started after an accidental fall. X-ray images show a structural osteoblastic alteration of the 1st sacral vertebra (yellow arrow)

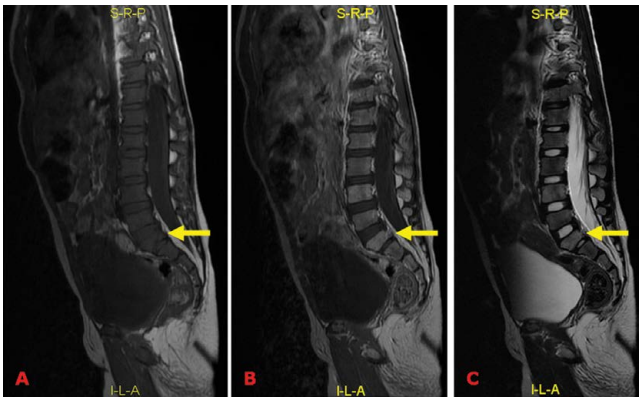

Figure 2A–C. On sagittal T1-weighted images (**A**) there is diffuse abnormal hypointense bone marrow with multiple mild compression fractures of superior endplate involving D8, D9, D12, L1 and, particularly S1. After administration of paramagnetic contrast (**B**) there is patchy enhancement of the bone marrow more evident at S1 and L4 levels. The sagittal T2-weighted images (**C**) show heterogeneous bone marrow signal involving S1 and L4. Findings were possibly related to post-traumatic alteration or pathologic replacement of the bone marrow. Finally a ^{18}F-FDG-PET/CT was requested in order to exclude a possible lymphoproliferative disease. The PET/CT scan revealed abnormal uptake in the soma of L4 (SUVmax: 2.9), L5 (SUVmax: 2.19) and S1 (SUVmax: 2.13) and an additional site of disease not revealed by MRI in the sternum (Figure 3). On the basis of the imaging results, a bone-marrow biopsy was performed and addressed the correct diagnosis revealing an abnormal pattern consistent with acute lymphoblastic leukaemia – early B (lymphoid immature cells CD19+/10+/34+/58, 4% of blast cells with phenotype ALL COMMON). Consequently, the girl was treated with chemotherapy according AIEOP_BFM LLA 2009 protocol (Predinisone, Teicoplanin, and VCR/DNM) showing a good response (WBC 890/mmc, disappearance of the blastic cells).

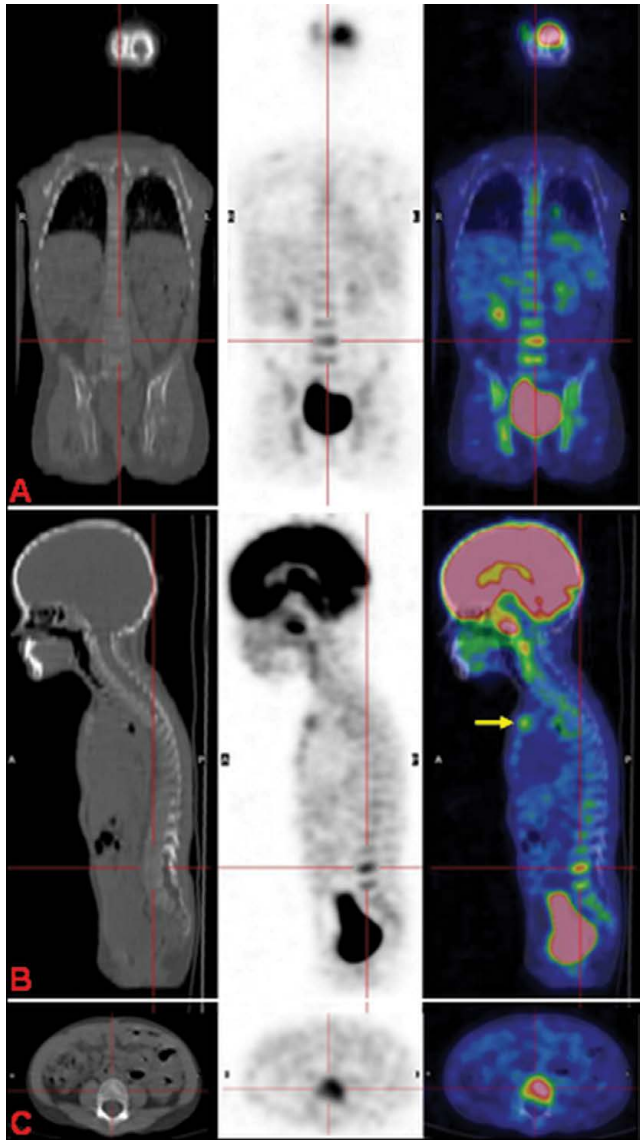

Figure 3A–C. Coronal (**A**), axial (**B**) and sagittal (**C**) CT, ^{18}F-FDG PET, PET/CT fusion images showing abnormal uptake in the soma of the 4th, 5th lumbar vertebrae and S1, and an additional site of disease not revealed by MRI in the sternum (yellow arrow in the sagittal PET/CT fused image)

Discussion

ALL is a serious haematological disease affecting mainly pediatric patients. Primary involvement or recurrence of ALL can occur in the testicles (2%) [1] and the central nervous system (CNS) (5–11%) [2]. Other possible sites of disease include ovaries, breast, eye, skin, and lymph nodes [3]. To the best of our knowledge, there is limited lack of reports regarding ALL with bone involvement as primary involvement in pediatric patients, valuated by ^{18}F-FDG PET/CT [4].

This case shows the usefulness of ^{18}F-FDG PET/CT, as full-body imaging exams, in detecting extra-haematological sites of disease in a patient with diffuse bone involvement as initial manifestation of ALL. In our case, ^{18}F-FDG-PET/CT was helpful in detecting an additional lesion (in the sternum) and in suggesting the presence of a lymphoproliferative disease, subsequently confirmed by the bone marrow biopsy. MRI is usually performed only in selected districts on the basis of the clinical suspicion [5]. It follows that sites of disease beyond the field of view may be missed. In our patient PET/CT was able to reveal the pathological bone involvement and played a crucial role in the clinical management, suggesting the need of a bone marrow examination and yielding a prompt initiation of the chemotherapy.

Nowadays PET/CT is gaining increasing importance in the diagnostic work-up of several diseases in pediatric patients [6–8], but is not routinely used in ALL yet. The role of PET/CT in pediatric patients needs to be further evaluated, considering the effective dose, ranging from 7.3 to 9.3 mSv, provided by using a standard PET/CT protocol (tube voltage, 120 kVp; tube current, 80 mAs; and abdominal pitch, 1.5:1) [9].

Potential dose reduction and additional diagnostic benefit could be reached in the assessment of possible multifocal bone marrow involvement by combining PET and MRI data in a whole-body examination by introducing hybrid PET/MRI in the evaluation of pediatric patients with ALL [9, 10].

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