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CASE REPORT

Unveiling hidden trails: The crucial role of 2-[^{18}F]FDG PET/CT scan in detecting rare pathologies like B Cell acute lymphocytic leukemia in a young girl presented with pyrexia of unknown origin

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ABSTRACT

This case report illuminates the pivotal role of 2-[^{18}F]fluoro-2-deoxy-D-glucose ([^{18}F]FDG) PET/CT (Positron emission tomography integrated with computed tomography) scan in diagnosing uncommon and elusive pathologies. Through the detailed exploration of a challenging case, we underscore the significance of this imaging modality in unravelling diagnostic mysteries, guiding clinical decision-making, and ultimately improving patient outcomes. This case highlights the importance of considering haematological malignancies in the differential diagnosis of pyrexia of unknown origin (PUO), especially when accompanied by cytopenia and bone abnormalities. PET/CT scan revealed extent of disease involvement, it also guided to determine the site of bone marrow biopsy and to decide treatment protocol as well as in response assessment.

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INTRODUCTION

Pyrexia of unknown origin (PUO) is a diagnostic challenge encountered in clinical practice [1]. While infectious, inflammatory, neoplastic, and autoimmune aetiology are commonly considered certain conditions evade detection through conventional diagnostic methods [2]. Haematological malignancies presenting as PUO are relatively rare but important to recognize. Herein, we describe a case of PUO revealing B-cell Acute Lymphoblastic Leukaemia (B-ALL) in a young girl. Advanced imaging techniques like [^{18}F]FDG PET/CT scan emerge as indispensable tools, offering unparalleled insights into the underlying pathophysiology. PET guided bone marrow aspiration and biopsy provided diagnostic result in above case [3, 4].

This report elucidates the invaluable role of [^{18}F]FDG PET/CT in elucidating a complex case, to know extent of disease, guiding site of biopsy, deciding treatment protocol and response assessment [5, 6].

CASE PRESENTATION

A 19-year-old girl was admitted with a perplexing constellation of symptoms, including intermittent fever, generalized body ache, significant weight loss, anorexia, and body pain. Physical examination revealed pallor, pedal edema, but no icterus, clubbing, cyanosis, or lymphadenopathy. Vital signs were stable. Laboratory investigations showed anaemia, thrombocytopenia, elevated LDH, and increased inflammatory markers. Infective etiology workup, including thyroid and viral markers were negative.

Despite exhaustive investigations, including routine laboratory tests, infective etiology workup, and imaging studies, the underlying cause remained elusive.

[^{18}F]FDG PET/CT scan (Figure 1) revealed diffusely increased tracer uptake in the axial and appendicular skeleton, along with [^{18}F]FDG avid lytic lesions in bilateral pelvic bones and patchy bone marrow uptakes in the distal appendicular system. Notably, bone and marrow abnormalities detected on [^{18}F]FDG PET/CT scan imaging prompted further evaluation.

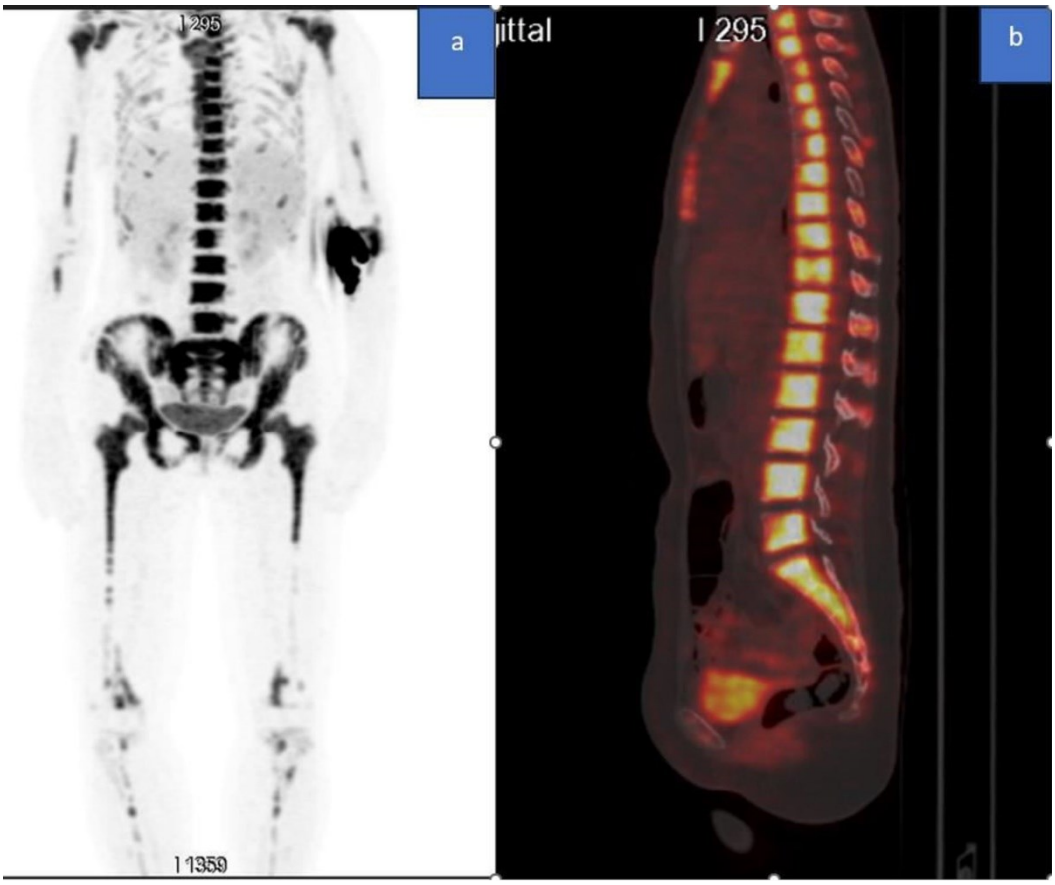

Figure 1. (a) MIP (maximum intensity projection images and (b) fused PET CT scan sagittal view image in bone window shows diffuse involvement of bone marrow in both axial and appendicular skeleton

Patient was advised bone marrow biopsy. Hematoxylin Eosin stained Bone marrow biopsy (Figure 2) shows hypercellular marrow, replaced by monomorphic blastoid cells with high nucleocytoplasmic ratio, open chromatin and occasional visible nucleoli, there was diffuse grade 2 myelofibrosis as highlighted on reticulin stain, these blastoid cells were positive for CD 19 and CD 34 and negative for CD 3, MPO and CD 20 indicating of B lymphoid acute lymphoblastic leukemia in bone marrow. This comprehensive imaging assessment not only delineated the extent of disease involvement but also provided crucial guidance for therapeutic decision-making. The patient was started on high-risk Berlin-Frankfurt-Münster (BFM) 02 ALL protocol. On completion of therapy bone marrow study was done and she was found to be in morphologic remission (Figure 3). Measurable residual disease (MRD) by flow cytometry was less than 0.01%. She was subsequently continued on consolidation chemotherapy. As she had fully matched sibling, she was taken up for allogeneic hematopoietic stem cell transplant (HSCT) after 02 cycles of high dose methotrexate consolidation. She remains in remission after HSCT. In view of above bone marrow transplant was planned. The case reporthighlights the pivotal role of [^{18}F]FDG PET/CT in expediting diagnosis and facilitating timely intervention.

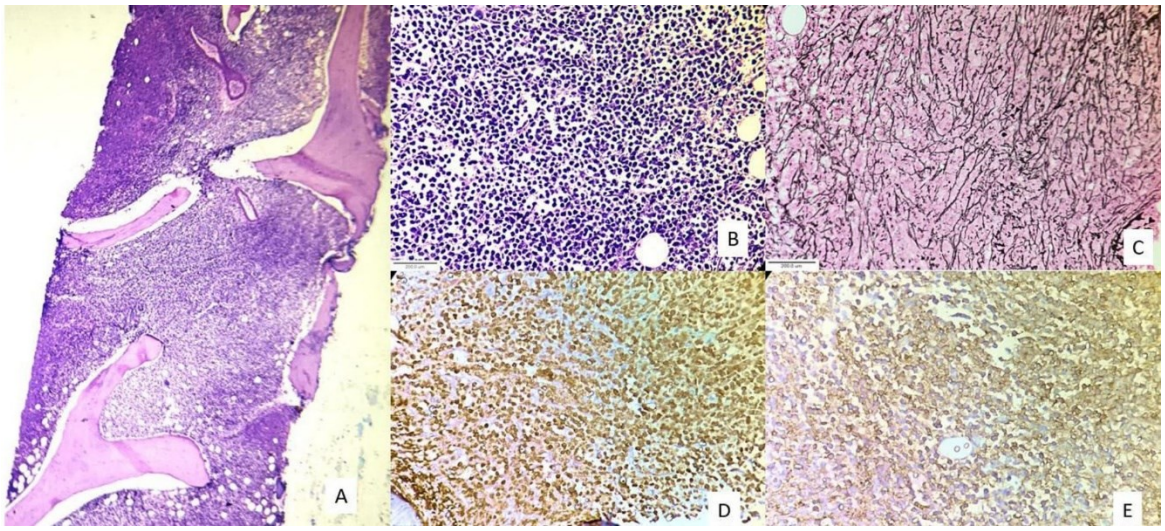

Figure 2. (A) Hematoxylin Eosin stained bone marrow biopsy shows hypercellular marrow, replaced by monomorphic blastoid cells with high nucleocytoplasmic ratio, open chromatin and occasional visible nucleoli (B). There was diffuse grade 2 myelofibrosis as highlighted on reticulin stain (C). These blastoid cells were positive for CD 19 (D) and CD 34 (E) and negative for CD 3, MPO and CD 20 indicating of B lymphoid acute lymphoblastic leukemia in bone marrow

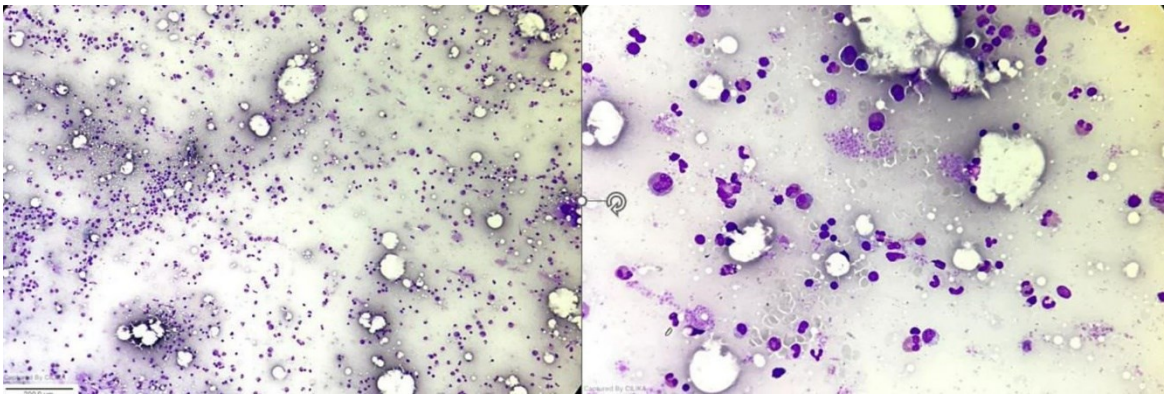

Figure 3. Leishman Giemsa stained bone marrow smears were cellular, reactive and were in morphological remission. No increase in blasts noted on aspirate or biopsy

DISCUSSION

B-ALL is a rare cause of PUO, it is even less common in young patients. The patients generally show cytopenia, elevated LDH, and bone abnormalities. Patients with above findings merits consideration of haematological malignancies. PET/CT scan plays important role in assessing disease extent and guiding management.

This was a challenging case of a young female presenting with non-specific symptoms. Given the broad differential diagnoses, a stepwise and systematic approach was necessary to elucidate the underlying pathology.

On investigations patient's laboratory tests and biochemical findings are suggestive of a haematological disorder, as patient was having anaemia, thrombocytopenia, elevated lactate dehydrogenase (LDH), along with increased inflammatory markers. On investigation infectious markers were absent suggestive of a non-infectious aetiology. But battery of investigation failed to pinpoint the exact diagnosis, hence necessitating advanced imaging modalities like [^{18}F]FDG PET/CT scan.

The [^{18}F]FDG PET-CT scan played important role in clinching the diagnosis. The [^{18}F]FDG PET/CT scan shows diffusely increased tracer uptake in the axial and appendicular skeleton, with [^{18}F]FDG-avid lytic lesions in the bilateral pelvic bones and patchy bone marrow uptake in the distal appendicular system. The [^{18}F]FDG PET/CT scan findings are suggestive of hematologic malignancy. To reach the final diagnosis targeted bone marrow evaluation from the most accessible and metabolic active site was advised.

Bone marrow biopsy reveals the presence of hypercellular marrow extensively infiltrated by monomorphic blastoid cells with high nucleocytoplasmic ratios, open chromatin, and occasional nucleoli. Immunohistochemical staining shows positivity for CD19 and CD34, negative for CD3, MPO and CD20, suggestive of diagnosis of B lymphoid acute lymphoblastic leukaemia (B-ALL). As it was aggressive disease in view of the presence of diffuse grade 2 myelofibrosis, early treatment is essential to improving the outcomes [7].

CONCLUSION

This case shows the importance of [^{18}F]FDG PET/CT scan in diagnosing hematologic malignancies, where conventional investigations results are inconclusive. The [^{18}F]FDG PET/CT scan helps not only in early diagnosis but also guided appropriate diagnostic decisions in form of planning for appropriate site for bone marrow aspiration. It also helps in assessment of risk stratification and treatment response. Early initiation of intensive chemotherapy followed by HSCT was instrumental in achieving sustained remission. It further highlights the significance of timely intervention in high-risk all cases. [^{18}F]FDG PET/CT enables clinicians to overcome diagnostic challenges with precision and confidence. The scan is able to detect subtle abnormalities and it also guide in targeted interventions to reach definitive diagnosis.

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