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Case Report

^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography as a metabolic marker for functional assessment of spinal tuberculosis after early decompression surgery

ABSTRACT

Tuberculosis (TB) of the spine is the most important extra pulmonary form of TB. The lytic destructive variant of spinal TB can destroy the intervertebral discs, vertebral body, collapse, kyphotic deformity, and spinal cord compression. Complicated Pott's disease if not managed early can lead to neurological deficits, so there is a need for early surgical decompression, compliant anti-tubercular therapy, and response evaluation tool. We present two cases of multilevel dorsal spinal TB diagnosed on magnetic resonance imaging spine and baseline ^{18}F-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) scan. They underwent early decompression with internal fixation and were followed up for 18 months with serial ^{18}F-FDG PET/CT at 3rd and 18th month, respectively. One patient showed an early complete metabolic response and excellent functional recovery. Another patient showed progressive disease (drug-resistant status) and delayed functional recovery. ^{18}F-FDG PET/CT has an excellent role in assessing response to therapy and thus helps to achieve therapeutic endpoint.

Keywords: ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography in spinal decompression assessment, ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography in spinal tuberculosis, monitoring pott's spine

INTRODUCTION

Tuberculosis (TB) of the spine is the most important extra pulmonary TB (ETB), which can cause significant morbidity and permanent neurological damage. It accounts for ~50% of the cases of ETB and affects about 1%–2% of TB worldwide.[1] The most common involvement is seen in the dorsal spine.[2]

The lytic destructive variant of spinal TB can destroy the intervertebral discs, vertebral body, collapse, kyphotic deformity, and spinal cord compression.[3]

Magnetic resonance imaging (MRI) has been the cornerstone and preferred standard investigation for the assessment of the spine in spinal TB.[4] ^{18}F-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) is a new diagnostic investigation in infection and inflammation imaging. It maps the radioactive glucose uptake by the infection/inflammatory process and gives a quantitative assessment using "Standardized uptake value" (SUV_{max}). SUV_{max} helps to assess the aggressiveness of

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Kasturi Rangan, Amrin Israrahmed[1], Ajay Singh Suraj, Sanjay Gambhir

Departments of Nuclear Medicine and [1]Radiology, SGPGI, Lucknow, Uttar Pradesh, India

Address for correspondence: Dr. Kasturi Rangan, No 211, New PG, SGPGIMS, Lucknow - 226 014, Uttar Pradesh, India.
E-mail: kasturi.rangan123@gmail.com

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the disease and can be used to monitor the therapy response in the follow-up scans.

Depending on the aggressiveness of the disease process, surgical or medical management of the Pott's spine can be decided. Early surgical decompression can substantially decrease the morbidity of the patient.

Anti-tubercular treatment (ATT) for Pott's spine has to be taken for 18 months, but no standard protocol has been set to decide when to stop the treatment.[5] Hence, we try to explain the role of follow-up using ^{18}F-FDG PET/CT scans for assessing the therapy response.

CASE REPORT

The first patient is an 18-year-old female, presented with fever, upper back pain, lower limb numbness, and restricted movement for 1 month. On examination, she had low-grade fever and tenderness over the midline at the upper back region. She had lower limb paraparesis with power 1/5, restricted straight leg raising test, positive ankle, and knee jerk reflex. Laboratory investigation reveal erythrocyte sedimentation rate (ESR): 43 mm/h, white blood cell (WBC): 11900 cells/mm^3, C-reactive protein (CRP): 34 mg/L. MRI, [Figure 1] dorsal spine revealed anterior wedging of T3/T4 vertebral bodies with posterior cortical bulging (gibbus) causing kyphotic deformity. In addition, altered magnetic resonance (MR) signal in T2, T3, T4 vertebral bodies along with paravertebral collection extending from C7 to T5. ^{18}F-FDG PET/CT [Figure 1] done on the next day revealed similar findings as MRI (SUV_{max}-18.4 in T3/4) and besides, revealed extensive cervical (SUV_{max}-12.7) and mediastinal lymphadenopathy (SUV_{max}-13.7). Considering this surgery was planned for the dorsal spine. Intraoperatively, granulation tissue and destructive bones were removed and the abscess was aspirated. The dorsal cord was decompressed and a metallic cage with lateral internal fixation was performed. Histopathology confirmed to be TB and the patient was started on ATT. Follow-up ^{18}F-FDG PET/CT [Figure 2] scans were done on the 3rd month and 18th month after surgery, which showed complete resolution of all lesions. The patient regained her full neurological capability in both the lower limbs.

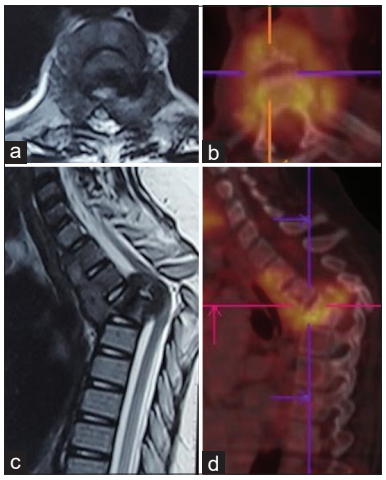

Figure 1: Baseline scan-{[A(axial),C(sagittal)-T2 weighted Magnetic Resonance Imaging], [B(axial) & D(sagittal) fused Positron emission tomography/computed tomography]}: Anterior wedging of T3/T4 vertebral bodies with posterior cortical bulging (gibbus) and kyphotic deformity. Altered signal intensity & FDG avidity in T2, T3, T4 vertebra. Pre and Paravertebral soft component extending from C7 to T5 vertebral body level

The second case is a 22-year-old female, complaints of fever, cough, upper back pain, and lower limb weakness for 21 days. On examination, she had low-grade fever and tenderness in the upper dorsal region. She had lower limb paraparesis with power 2/5, restricted straight leg raising test, and positive ankle and knee jerk reflex. Laboratory investigation reveals ESR: 28 mm/h, WBC: 9800 cells/mm^3, CRP: 22 mg/L. MRI [Figure 3] of the dorsal spine revealed wedging of T6/T7 vertebral bodies, T6/7 intervertebral disc changes with epidural soft-tissue causing thecae compression and spinal cord narrowing. In addition, altered MR signals in T5, T8 vertebral bodies, and prevertebral collections were seen extending from T5 to T8. ^{18}F-FDG PET/CT [Figure 2] done on the next day revealed similar findings as MRI (SUV_{max}-16.9 at T6/7), besides revealed

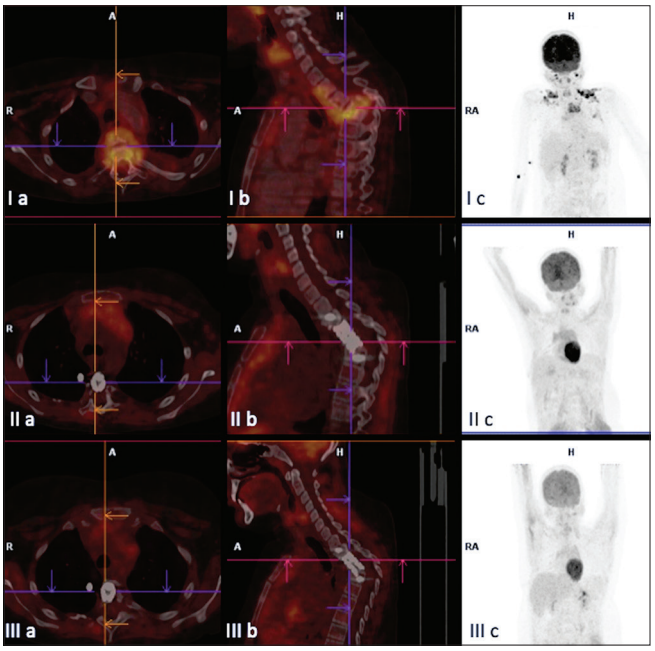

Figure 2: Positron emission tomography-computed tomography ([a-c; axial, sagittal, maximal intensity projection], [I-baseline, II-3rd month, III-18th month]) - fluorodeoxyglucose avidity (Standardized uptake value max-18.4) with Anterior wedging of T3/T4 vertebral bodies associated with posterior cortical bulging (gibbus), kyphotic deformity and extensive cervical (Standardized uptake value max-12.7)/mediastinal lymphadenopathy (Standardized uptake value max-13.7). Underwent Lateral Internal fixation with metallic cage. No fluorodeoxyglucose avid focus at 3rd month and 18th month scan

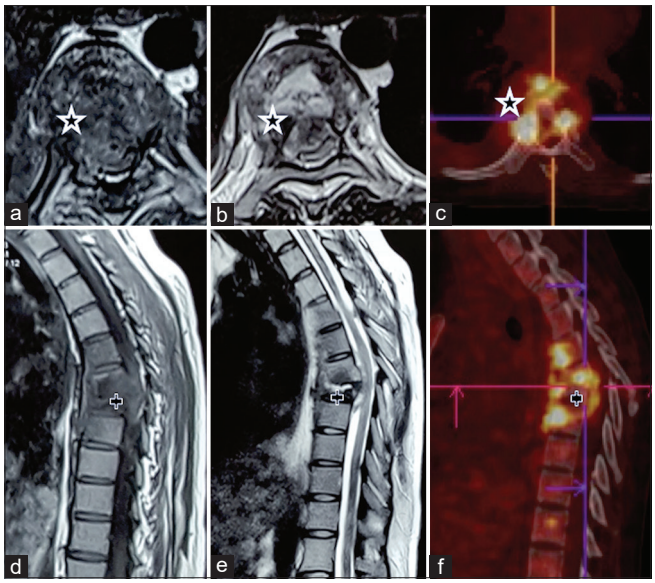

Figure 3: Baseline scan (a-T1-weighted axial, b-T2-weighted axial, c-Axial positron emission tomography-computed tomography, d-T1-weighted sagittal, e-T2-weighted sagittal, f-sagittal positron emission tomography-computed tomography); fluorodeoxyglucose avid (Standardized uptake value max-16.9), anterior wedging of T6/T7 vertebral bodies with mild posterior displacement, T6-7 intervertebral disc changes with epidural soft-tissue causing altered signal intensity on the spinal cord with canal narrowing. Altered marrow signal and fluorodeoxyglucose avidity (Standardized uptake value max-10.6) was noted in T5/T8. Prevertebral collection extending from T5 to T8 vertebral body level. * and + symbol is representation of the disease affected vertebra

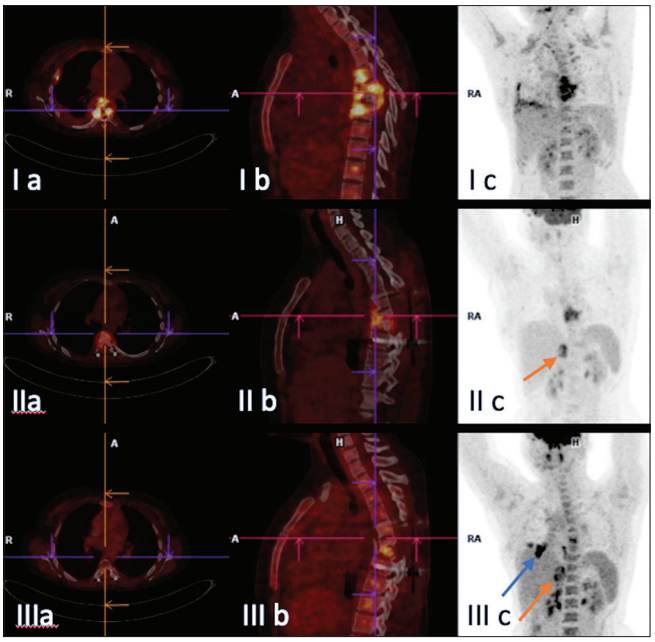

Figure 4: Positron emission tomography-computed tomography ([a-c; axial, sagittal, maximal intensity projection]. [I-baseline, II-3rd month, III-18th month]) - fluorodeoxyglucose avidity (Standardized uptake value max-16.9) in anterior wedging of T6/T7 vertebral bodies with mild posterior displacement, T6-7 intervertebral disc changes with epidural soft tissue component, right pleural and right loculated effusion. Underwent posterolateral internal fixation with the pedicle screw. At 3rd month, positron emission tomography/computed tomography revealed the persistence of the right loculated effusion at cardiophrenic angle (IIc, orange arrow). At 18th month positron emission tomography/computed tomography, a substantial increase in the size and avidity of the right loculated effusion at cardiophrenic angle (IIIc, Orange arrow) and appearance of new oblique fissure effusion (IIIc, Blue arrow)

extensive right pleural involvement (SUV_{max}-4.5), right loculated effusion (SUV_{max}-4.2). Considering this surgery was planned for the dorsal spine. Intraoperatively, granulation tissue, destructive bone were removed and prevertebral abscess aspirated. The dorsal cord was decompressed and a pedicle screw with posterolateral internal fixation was done. Histopathology revealed TB and ATT started. Follow-up ^{18}F-FDG PET/CT [Figure 4] scan done on the 3rd month showed partial resolution of the spinal lesion (SUV_{max}-4.7) and persistence of located effusion at right cardiophrenic angle (SUV_{max}-9.7). PET/CT at 18th month showed partial resolution of the T6-7 vertebral lesion (SUV_{max}-3.4), a substantial increase in the size and avidity of the right cardiophrenic loculated pleural effusion (SUV_{max}-10.3) and appearance of the right oblique fissure effusion (SUV_{max}-11.2). Hence, there was disease progression. Ultrasonography-guided aspiration of the cardiophrenic abscess revealed isoniazid isonicotinic acid hydrazide (INH) resistant TB. She was put on a higher dose of INH and re-evaluated after 3 months. She responded well with better neurological recovery (power was 4/5).

DISCUSSION

TB spondylitis is seen in countries with a high prevalence of pulmonary TB.[1] The most commonly affected spinal site is the dorsal spine.[2] TB of any origin presents with weight loss, fever, night sweats, whereas severe back pain and neurological deficit direct toward spinal TB.[6] The disease progressively causes vertebral collapse, destruction, abscess formation, which trickles to adjacent pre/para/epidural spaces, subsequently causing spinal cord compression, kyphotic deformity, and neurological deficits.[7,8] Our first patient responded beautifully to early surgical decompression and showed an early complete metabolic response in PET/CT. Whereas our 2nd patient, even though she had a responding spinal disease, developed loculated pleura effusion, which progressed in the 3rd PET/CT. On further analysis, it turned out to be INH-resistant TB. Hence, ^{18}F-FDG PET/CT helped in assessing the whole body of the patient in a single go, thereby focusing our mind on the actual disease process. Few of the authors have used ^{18}F-FDG PET/CT as a monitoring marker for assessing the metabolic changes in the course of therapy.[5] Timeline for the assessment of therapy response has been suggested for 6, 12, 18 months for skeletal TB evaluation.[9,10]

PET/MRI is a powerful tool in the block, with both functional and anatomical capabilities. Excellent spatial resolution

combined with metabolic evolution and reduced overall patient radiation dose is a few of the important advantages in comparison to PET/CT.[11] Cost is the only limiting factor.

CONCLUSION

^{18}F-FDG PET/CT is a one shop stop modality for assessing the whole body disease burden at the start of the treatment, monitoring the disease response to therapy and help in guiding the physicians to reach a therapeutic endpoint.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot bechrological order guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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