

^{18}F -FDG-PET/CT findings in patients affected by spondylodiscitis

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Abstract

Spondylodiscitis (SPD) is an inflammatory process of the intervertebral disc space. We report two cases of patients affected by SPD evaluated by fluorine-18 fluorodesoxyglucose positron emission tomography/computed tomography, which was useful in detecting SPD and supporting differential diagnosis.

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Introduction

Spondylodiscitis (SPD) is an inflammatory process of the intervertebral disc that can lead to sepsis, septic discitis and ankylosing spondylitis (AS). Its incidence increases with age and infection could be haematogenous after a primary infection elsewhere in the body or infection may be inoculated into the intervertebral disc during invasive spinal procedures. A single species of bacteria or, less frequently, polybacterial infections are involved. Most common are Gram-negative bacilli, such as *Escherichia coli*, *Proteus mirabilis*, *Enterococcus*, *Pseudomonas aeruginosa* and *Brucella* [1]. *Bacillus Koch*, non-tuberculous mycobacterium as *Mycobacterium Xenopi* [2] or fungal pathogens like *Candida albicans* and *Aspergillus* can also be isolated from immunosuppressed patients. Clinical presentation is characterised by pain, fever in about one-third of cases, weight loss, anorexia and occasionally neurological deficit. A rise in erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) is usually seen, while leucocytosis is occasionally present [3]. Computerized tomography (CT) yields positive findings in the early stages of SPD and can also be used to guide disc biopsy or drainage of a paravertebral collection. The most accurate method, which provides better definition of the epidural and paravertebral spaces and also allows assessment of compression of neural elements is magnetic resonance imaging (MRI). Despite the documented utility and accuracy of these techniques, CT and MRI could be less reliable when post-surgical changes, scarring or implants are present. Radionuclide scans with gallium-67 citrate ($^{67}\text{Ga-C}$), bone scintigraphy, technetium-99m/ciprofloxacin or radiolabelled antifungal tracers are sensitive to abnormal metabolic activity and the last two are also specific.

The definitive diagnosis of SPD is made by the isolation of pathogens from intra-operative cultures, the spinal implant or the bone lesion, by histopathological analysis, or blood cultures [4]. Antibiotic treatment is mandatory. Most authors favour immobilization which may take the form of bed rest or a brace [3, 5]. Surgery may be indicated for the resolution of significant spinal cord or radicular compression, for prevention or correction of biomechanical instability and deformity, for the management of severe persistent pain, or for drainage of abscesses. Surgery may also be necessary when the principal aim is debridement of infected tissues, protecting an adequate blood supply for tissue healing and maintenance or restoration of spinal stability [3, 5]. Patients should be followed up by clinical assessment of pain and neurological features, laboratory assessment with serial monitoring of CRP and ESR, and radiological examination by plain radiographs throughout treatment and for one year after its completion in order to detect relapses [3, 5]. A follow-up MRI or CT is usually unnecessary if clinical and laboratory parameters indicate a favourable response like reduction of back pain and recovery of constitutional symptoms [3, 5]. It is sometimes difficult to correctly diagnose and treat SPD.

Cases description

We have diagnosed two patients with SPD. They were evaluated by ^{18}F -FDG/PET/CT that was performed in the fasting state for at least 6h and with glucose level lower than 150mg/dL. An ^{18}F -FDG dose of 5.5MBq/kg was administered intravenously and a 2D mode ordered-subset-expectation-maximization (OS-EM) imaging (with septa) was acquired 60min after injection on a Discovery ST PET/CT tomography (General Electric Company-

GE®-Milwaukee, WI, USA) with standard CT parameters (80mA, 120kV without contrast; 4min per bed-PET-step of 15cm). The reconstruction was performed in a 128×128 matrix and 60cm field of view. The PET images were analyzed visually and semi-quantitatively by measuring the maximum standardized uptake value (SUVmax) that was expressed as SUVbody weight (SUVbw-g/ml) and automatically calculated by the software (volumetrix for PET/CT; Xeleris™ Functional imaging workstation; GE/USA) on the basis of the following parameters: weight of the patient expressed in kilograms; height expressed in centimetres; tracer volume expressed in mL; radioactivity at injection time expressed in MBq; post injection activity in the vial expressed in MBq; injection time; starting time acquisition; decay half-time of the radionuclide (standard 109.8min for ¹⁸F-FDG). A written consensus was obtained by the patients.

The first patient was a 75 years old male, who had undergone surgical intervention for discal hernia between the fourth and fifth lumbar vertebrae one year before, and recently underwent a PET study during follow-up after surgical resection of lung cancer. The patient at the time of the study had a slight back pain and the ¹⁸F-FDG/PET/CT revealed high focal uptake (SUVmax 3.7) at the centre of the intervertebral disc. Although ¹⁸F-FDG/PET/CT imaging cannot differentiate between neoplastic lesion and active inflammatory or infective disease, it can indicate the site of abnormal uptake, the absence of other lesions suspicion of SPD, which suggested the exclusion of metastatic disease. The second patient was a 63 years old female who underwent a PET study 8 months after surgical intervention for discal hernia because it was suspected that he had developed SPD (Fig. 1-B4-6). The patient at the time of the study had back pain, elevated ESR and CRP, and the ¹⁸F-FDG/PET/CT revealed high focal uptake (SUVmax 4.7) at the intervertebral disc between the fifth lumbar (L5) and first sacral vertebrae (S1). The MRI confirmed the suspicion of SPD by revealing contrast medium enhancement at L5, S1 and the intervertebral disc. Biopsy documented an inflammatory process and areas of reactive fibrosis. No specific pathogens were isolated. In both patients after wide spectrum antibiotics and anti-inflammatory treatments there was clinical remission and normalization of laboratory tests.

Discussion

In recent years the role of ¹⁸F-FDG-PET/CT in inflammatory and infectious diseases, besides cancer is growing since it has been useful in cases of fever of unknown origin, infected prostheses, osteomyelitis, sarcoidosis, arteritis, and rheumatoid arthritis among other diseases [6-8]. The radiopharmaceutical accumulates in inflammatory cells like neutrophils, lymphocytes, macrophages and in the granulomatous tissue [9].

Nuclear medicine literature in the field of SPD is limited. Some authors have studied 16 patients with suspected SPD in whom histopathological examination confirmed that ¹⁸F-FDG-PET was true-positive in 12 of them. The mean SUV of ¹⁸F-FDG was 7.5; (standard deviation = ±3.8). Four other patients in the same study without SPD, showed three true-negative and one false-positive results [10]. In our study the SUVmax was respectively 3.7 in the first patient and 4.7 in the second.

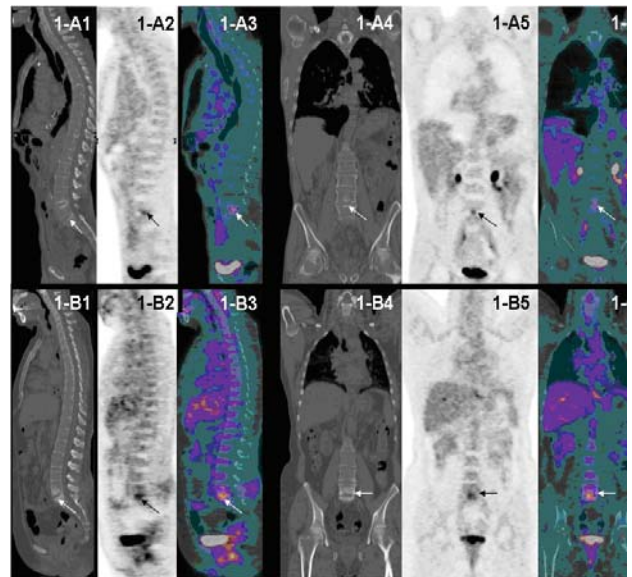


Figure 1. Sagittal CT (1-A1), PET (1-A2), fused (1-A3) images and coronal CT (1-A4), PET (1-A5), fused (1-A6) images of first patient affected by discitis between the fourth and fifth lumbar vertebrae; sagittal CT (1-B1), PET (1-B2), fused (1-B3) images and coronal CT (1-B4), PET (1-B5), fused (1-B6) images of second patient affected by discitis of the intervertebral disc between the fifth lumbar and first sacral vertebrae.

Others have studied with MRI 3 patients affected by AS and have documented lumbar aseptic SPD, which required anti-tumour necrosis factor (TNF) treatment (infliximab 5mg/kg or etanercept 25mg twice/week) before and 6-8 weeks after treatment. Imaging with ¹⁸F-FDG-PET/CT showed reduction of ¹⁸F-FDG uptake on the SPD in all these patients after treatment even if they did not observe a correlation between reduction of ¹⁸F-FDG uptake and clinical and MRI evolution [11].

Others have investigated sixteen patients with suspected SPD and showed that ¹⁸F-FDG-PET/single photon emission tomography (SPET) was superior to MRI not only in patients who had a history of surgery and suffered from a high-grade infection with paravertebral abscess formation, but also in cases of low-grade SPD or discitis, which is a finding less expected [12]. Conventional radiography may take up to 8 weeks to show the abnormality [13]. Computed tomography yields positive findings in the early stages and demonstrates hypodensity and flattening of the involved disc, erosion of the vertebral body and endplate, soft tissue swelling and obliteration of fat planes around the vertebral bodies [3, 14-16].

The most sensitive modality, with sensitivity of 93%-96% and specificity of 92.5%-97% for early detection of SPD is MRI as it can differentiate between pyogenic discitis, neoplasia and TB, provide better definition of the paravertebral and epidural spaces and allow assessment of compression of neural elements [3, 16, 17]. Morphological imaging techniques rely on structural changes to make diagnosis but when normal anatomy is distorted by post-surgical changes or scarring or in the presence of implants, these techniques are less reliable [13]. Functional imaging studies are performed to improve diagnostic accuracy showing high negative predictive value, especially in these cases.

FN may be a result of regional ischemia, suggesting that a negative scan might not reliably exclude infection in the context of arteriosclerosis [15]. Gallium-67-C imaging is often used as a complement to bone scintigraphy to enhance the specificity of the study and to detect extra-

osseous sites of infection. Bone scintigraphy is widely available, easily performed and rapidly completed, but is not specific. Three-phase bone scintigraphy with SPET and analysis of uptake patterns could enhance the accuracy of the ^{99m}Tc -MDP scan [13,18,19]. Other tracers for diagnosing spinal infection are being developed, including radiolabelled antibiotics, such as ^{99m}Tc -ciprofloxacin, streptavidin/indium-111-biotin complex, and radiolabelled antifungal tracers, which offer the potential to differentiate between fungal and bacterial infections [13]. In particular, Tsopelas et al (2003) have used a radiolabeled antibiotic peptide ^{99m}Tc -alafosfalin as an infection imaging agent in a rat model in comparison to both ^{99m}Tc -diaethylene triamino penta acetic acid (^{99m}Tc -DTPA) and ^{99m}Tc -leukocytes and showed better accumulation at sites of infection than ^{99m}Tc -DTPA, and less accumulation than ^{99m}Tc -leukocytes; these distribution characteristics could be an advantage in imaging abdominal and soft tissue infection [20].

Moreover, follow-up and treatment monitoring are pivotal aspects of clinical management of SPD. There is little information on the ability of imaging methods to predict residual disease and treatment efficacy in patients with spine infections. Others in 30 patients have recently showed that ^{18}F -FDG-PET/CT is also useful for the discrimination of residual and nonresidual spine infections after treatment [21].

In conclusion, we present two cases of clinically suspected SPD diagnosed by ^{18}F -FDG-PET/CT with resolution of symptoms after treatment.

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