Diagnosis of Candida lung abscesses by 18F-fluorodeoxyglucose positron emission tomography

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ABSTRACT

In three patients with catheter-associated candidaemia, use of 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) led to the diagnosis of Candida lung abscesses, which was confirmed by computed tomography and a favourable response to antifungal therapy. It was concluded that FDG-PET is a promising new imaging technique that enables early identification of sites of disseminated candidiasis, and that this technique can be used in the evaluation of therapy.

Keywords Candida, central venous catheter, disseminated infection, FDG-PET, F-18-fluorodeoxyglucose positron emission tomography, lung abscess

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Candida spp. are an important cause of nosocomial bloodstream infection, and are associated with a mortality of 30–40% [1]. Patients at high risk for candidiasis are those receiving total parenteral nutrition (TPN) and those that are critically ill [2–4]. Catheter-associated candidaemia may lead to seeding of Candida spp. to multiple organs. Timely identification and localisation of the infectious lesions are critical, but this is often difficult, especially in patients without signs indicating a specific localisation. The present study reports the use of 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) to diagnose three cases of Candida lung abscess associated with central venous catheter (CVC)-related candidaemia.

Patient A, a female aged 45 years, had received TPN since September 2003 because of short bowel syndrome resulting from acute bowel ischaemia. In January 2004, she was admitted with fever. Repeated blood cultures grew Candida albicans, which was also cultured from the catheter tip after removal, with a fluconazole MIC of 0.125 mg/L. Ophthalmological examination revealed lesions compatible with Candida chorioretinitis. The patient was treated with intravenous fluconazole 400 mg daily, but the fever persisted. Blood cultures remained positive for C. albicans for 7 days after the start of fluconazole therapy, and the dose was increased to 800 mg daily. Chest X-ray and abdominal ultrasound were both normal. Nine days after admission, FDG-PET was performed, which demonstrated increased FDG uptake in the upper and lower lobes of the right lung. High-resolution chest computed tomography (CT) subsequently showed several lesions with hypodense centres in the upper and lower lobes of the right lung, compatible with fungal abscesses. High-resolution chest CT after 6 weeks showed regression of the pulmonary densities. After 9 weeks, FDG-PET was normal and treatment with fluconazole was discontinued.

Patient B, a female aged 39 years, had received TPN because of chronic intestinal pseudo-obstruction since October 2003. In November 2003, she was admitted because of fever and rigors. Repeated blood cultures grew C. albicans, which was also cultured from the catheter tip after removal, with a fluconazole MIC of 0.125 mg/L. The patient was treated with intravenous fluconazole 400 mg daily. Fever persisted and the clinical condition deteriorated. Blood cultures remained positive for C. albicans for 2 days after the start of fluconazole. Abdominal ultrasound and Doppler ultrasonography of the subclavian and internal jugular veins were both normal. Chest X-ray was judged to be normal, but showed a small infiltrate in the left lower lobe upon re-examination. FDG-PET, performed 1 week after admission, demonstrated increased
FDG uptake in multiple foci in both lungs and subpleural, suggesting abscesses (Fig. 1a). Two days later, the patient developed pleuritic chest pain and a pleural rub on the right side. Chest CT showed multiple densities in both lungs compatible with fungal abscesses. Fluconazole was replaced by caspofungin. After 3 weeks, caspofungin was replaced by oral fluconazole. After 7 weeks, chest CT showed regression of the lung abscesses. After 9 weeks, FDG-PET was normal (Fig. 1b) and antifungal treatment was discontinued.

Patient C, a female aged 65 years, had been treated with prednisone and azathioprine since 1995 because of mixed connective tissue disease. In May 2004, the patient was admitted to the intensive care unit with *Streptococcus pneumoniae* pneumonia which required mechanical ventilation. Blood cultures remained sterile. Ten days after admission, blood cultures grew *Candida glabrata*. However, *C. albicans* and *C. glabrata* were both isolated from the CVC after removal, with fluconazole MICs of 4 and 8 mg/L, respectively. The patient was treated with intravenous fluconazole 400 mg daily, but the fever persisted and the dose was increased to 800 mg daily. Chest X-ray showed continued infiltrative changes in the left lower lobe. Abdominal CT revealed no signs of focal infection. Doppler ultrasonography of the subclavian and internal jugular vein was normal. The fever still persisted and blood cultures were positive for *C. glabrata* at 13 days after the start of fluconazole treatment. FDG-PET, performed after 12 days of therapy, showed increased FDG uptake in multiple foci in both lungs which suggested abscesses. Fluconazole was replaced by caspofungin. One week later, chest CT showed infiltrative changes in both upper lobes, compatible with metastatic infectious foci. After 6 weeks of antifungal treatment, CT showed improvement of the chest infiltrative changes and caspofungin was discontinued. FDG-PET has not been repeated.

These cases illustrate the difficulties in diagnosis and treatment of complicated catheter-related candidiasis. FDG-PET clearly revealed the sites of the disseminated *Candida* infection, which was confirmed by clinical signs (patient B), findings on chest CT, and response to antifungal therapy (patients A, B and C). In patients A and B, FDG-uptake normalised after prolonged treatment, in agreement with favourable clinical and laboratory responses, thereby enabling evaluation of the effect of antifungal treatment.

*Candida* spp. adhere avidly to vascular catheters. CVCs, even when not the primary source of candidaemia, may continue to serve as the source of sustained fungaemia as organisms adhere to the catheter surface and subsequently seed to target organs [5]. In a retrospective study in this hospital, 43 of 147 patients treated for candidaemia developed disseminated disease [6]; however, documented *Candida* lung abscesses are rare. In a study of 11 patients diagnosed with pulmonary candidiasis at necropsy, six cases were attributed to CVCs [7].

In patients A, B and C, chest X-ray did not reveal the lung abscesses, and is therefore not an appropriate diagnostic method to exclude disseminated pulmonary candidiasis. CT and ultrasonography are useful for diagnosing disseminated candidiasis, but are less suitable as screening methods for patients with candidaemia and suspected disseminated infection, but without clues to the specific sites of infection. Furthermore, these imaging techniques are not able to detect infectious foci at an early phase because of the absence of substantial anatomical changes at that time. Also, discrimination between active
infection and residual changes remains difficult, which is a drawback during follow-up of the effect of treatment.

Scintigraphic imaging allows delineation of foci localised in all parts of the body, based on functional changes of tissues. FDG-PET, an established imaging tool in oncology, is now being used for the diagnosis of clinical infectious diseases. After cellular uptake, FDG, an analogue of glucose, is trapped metabolically and provides an image which portrays glucose utilisation. Inflammatory cells take up large amounts of glucose as a result of an increased metabolic rate [8]. Previously, FDG-PET has proved valuable in diagnosing soft tissue infections, osteomyelitis, intravascular infections and fever of unknown origin [9,10]. Compared with conventional nuclear medicine techniques (67-gallium citrate and labelled leukocytes), the advantages of FDG-PET are early imaging and higher spatial resolution, resulting in more anatomical information [11]. Overall, FDG-PET appears to be a promising new imaging technique that enables early identification of the sites of disseminated Candida infection, as well as allowing the effect of antifungal treatment to be evaluated.

REFERENCES


RESEARCH NOTE

Nocardiosis in a teaching hospital in the Central Anatolia region of Turkey: treatment and outcome

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ABSTRACT

Predisposing factors, antimicrobial susceptibility patterns, treatment and outcome were analysed for nine consecutive patients with nocardiosis. Predisposing factors were identified in six (67%) of the nine patients. Clinical syndromes of nocardial infection were pulmonary infection (three patients), cerebral infection (five patients) and disseminated infection (one patient). The predominant (60%) species was Nocardia farcinica rather than the Nocardia asteroides complex. Treatment was started empirically, modified according

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