How to suspect a mycobacterial infection on FDG-PET/CT malignancy work-up?

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Learning objectives

The aim of the study is to describe the various patterns of presentation of pulmonary mycobacterial infection.

Background

Pulmonary mycobacterial infection is well described on chest CT, however its features in the PET/CT is not well detailed in the literature, only few clinical cases have been described [1-7].

Imaging findings OR Procedure details

METHOD AND MATERIAL

This retrospective study included 13 patients (9 men; median age 64, range 22-84 years), none of the patients were immunocompromised, all of them were HIV sero-negative.

The patients were referred to our department for an FDG-PET/CT suspecting malignancy on the base of clinical examination and chest X-ray: either lung cancer (n=10) or mediastinal lymphadenopathy (n=3).

In 10 patients mycobacterial infection was confirmed by bacteriological analysis, showing in the majority mycobacterium tuberculosis (n=8) as well as atypical mycobacteria such as mycobacterium fortuitum (n=1) or mycobacterium kanasii (n=1). None of the strains were multidrug resistant.

In the other 3 patients it was confirmed on histopathological bases with evidence of granuloma and caseous necrosis.

All PET/CT images were acquired on a 16-slice PET/CT (Gemini TF, Philips Medical systems, Netherland), from the skull base to the mid-thigh following intravenous injection of 3 to 3.5 MBq/Kg of FDG. Serum glucose level was < 105 mg at the time of injection. Associated non-enhanced CT scan was done using 120 KV and 100 mA parameters.
The images were analyzed by a physician (MS) with a double qualification in radiology and nuclear medicine.

Areas of increased uptake were evaluated qualitatively and quantitatively using the measurement of SUVmax in the following regions: lung parenchyma, mediastinal and hilar lymph nodes, extra thoracic lymph nodes, liver, spleen, bone and peritoneum.

We defined asymmetrical mediastinal or hilar lymph node uptake as a difference of uptake in SUVmax between the right and the left sides, superior to 20%.

The main CT scan findings in the thoracic compartment were the presence of areas of consolidation, ground glass opacities, nodules or micronodules, cavitations and lymph nodes. In the extrathoracic compartment liver, spleen, peritoneum or bone affection as well as lymphadenopathy were also investigated.

**IMAGING FINDINGS**

Focal or multifocal pulmonary uptake was present in 11/13 patients (median SUVmax = 5.4, interquartile range 3.9-6.5), involving the superior lobe or the apical segment of the inferior lobe in 9/11 patients.

Mediastino-hilar lymph nodes uptake were seen in all cases (median SUVmax = 5.4, interquartile range 3.9-6.5), the lymph nodes involvement was asymmetrical or unilateral in 12/13 patients. The lymph nodes average size was 19 mm (range 10-35). It was noticed that some lymph nodes were calcified (in 6/13 patients).

Extra thoracic uptake was seen in 8 patients: abdomino-pelvic and/or cervical lymph nodes (n=5), bone (n=1), peritoneum (n=1), liver and spleen (n=1). We observed that in the patients presenting extra-thoracic localisations, FDG uptake was globally superior (SUVmax median= 5.5 interquartile range 3.9-7.7 vs 3.3 interquartile range 2.8-5.1, p= 0.016). Patients with non-tuberculous mycobacterial infection had no extra-thoracic uptake.

**Three patterns could be differentiated in PET/CT:**

1. The lung pattern (n=8) (fig 1 on page and fig 2 on page): In this pattern there is a predominant thoracic involvement. We observed a focal or multimodal
uptake of lung consolidation surrounded by micronodules. It was often associated with
cavitation formation in 4/8 patients. Pathological Lymph nodes were slightly enlarged
and moderately FDG avid (median size: 14.5 mm interquartile range 11.5-19.5 / median
SUVmax: 3.4 interquartile range 2.8-4.7). Extra-thoracic involvement was present in 2/8
cases in the form of bone and lymph node.

2. The lymphatic pattern (n=4) (fig 3 on page and fig 4 on page): In
this pattern predominant lymphadenopathy was described. Mediastino-hilar lymph nodes
were FDG avid (median SUVmax: 6.4 interquartile range 5.5-9.8), with an average size of
31.5mm (interquartile range 27-33.5, p=0.04). Lymph node involvement was asymmetric
in all cases. Extra-thoracic implication was present in all cases with principal affection
of the abdomino-thoracic lymph nodes. Thoracic FDG uptake was more intense in this
pattern in comparison to the others (median SUVmax 6.4 vs 3.45, p=0.006, wilcoxon test).

3. The miliary pattern (n=1) (fig 5 on page): Lung micronodules distributed at
random related to haematogenous spread showed FDG uptake, it was also associated
to liver and spleen FDG uptake.

Conclusion

DISCUSSION

PET/CT imaging is a dual study including a conventional acquisition of body CT scan
fused with metabolic PET imaging. The analysis of the CT images in oncological workup
is crucial, improving the differential diagnosis to cancer. In our study we found that
when pulmonary mycobacterial infection was presented as lung and miliary patterns,
it could be already suggested on the base of the CT images only, with the presence
of lung consolidation, micronodules, cavitation for the lung pattern, or disseminated
micronodules for the miliary presentation. On the contrary when the lymph node
pattern was the presentation, it was sometimes more difficult to differentiate from other
pathologies exhibiting unilateral lymph node affection like metastasis, lymphoma or
atypical presentation of sarcoidosis.

Through our analysis we discerned 3 main added values of the PET/CT:

1. Detection of small sized pathological lymph nodes, with an apparently
   normal morphology on CT, by their FDG uptake.
2. Evaluation of the involvement of extra-pulmonary sites of TB spread, like the
   liver, the spleen or bones.
3. The activity of the disease could be qualitatively estimated through the extension of the lesions and the degree of FDG uptake [8].

The patterns of lung mycobacterial infection described in our study on the base PET/CT could be included in the discussion of recent knowledge of the physiopathology of mycobacterial infection. It was classically assumed that mediastinal lymphadenopathy associated with pleural effusion were characteristic of recent infection ("atypical presentation"), in opposition to upper lobe consolidation, micronodules or cavitations that were more likely considered to be a remote pulmonary TB infection ("typical presentation") [9].

This old concept tends to be replaced by new understanding of TB. According to recent bimolecular and genetic studies, the pulmonary presentation of the disease seems to dependent on multiple factors, like the genetic predisposition of the patient to be resistant to TB infection, the strength of the immune response against the infection or the virulence of the mycobacterium [10, 11]. So it is now proposed that a weak host immune response or a virulent pathogen could result in atypical presentation, and conversely that less virulent pathogen or an adequate immune response may predispose to more typical presentation [12].

In lymphatic or miliary patterns, the FDG uptake was relatively marked and the extra-thoracic locations were noted in all patients, reflecting the virulence of the infection. We can suppose that the first contact of the patient with the pathogens is a direct cause, or alternatively the role of a genetic predisposition as well as the virulence of strain of mycobacterium could be taken in consideration. In lung pattern the FDG uptake of the lymphadenopathy was moderate and the extra-thoracic expression of the disease was found in only 2/8 of the cases. The first contact of some patients with the pathogen may be have produced this picture, we can also suggest that it is rather the balance mycobacterial virulence/host immune response that played a favourable role in this less hypermetabolic and more restricted presentation of the disease.

**CONCLUSION**

The analysis of the CT images of the PET/CT is important to suggest mycobacterial infection as an alternative diagnosis in oncologic workup.

We have re-examined interesting added values of the PET/CT in the evaluation of TB, namely the detection of small sized pathological lymph nodes, a more global assessment of extra-pulmonary site of TB and finally the appraisal of the disease activity.

Moreover, we distinguished using FDG-PET/CT three patterns of presentation of the disease. Recent biomolecular and genetic studies proposed strong hypothesis about
the relation between the degree of immune response as well as the virulence of the mycobacterium and the pattern of manifestation of pulmonary TB. In the continuity of this approach we have suggested a probable relation between the intensity of FDG uptake and the considered pulmonary pattern.

Nevertheless we studied medical cases being examined for cancer workup, the question of concomitant pulmonary TB and bronchogenic carcinoma remain important.

Personal Information

References


