



Lung positron emission tomography with FDG in patients with haematological malignancies and acute respiratory failure

To the Editor:

Diagnostic strategy in haematology patients with pulmonary infiltrates relies on different approaches [1, 2]. Over the past decade, the use of ^{18}F -fluorodeoxyglucose (FDG) positron emission tomography (PET) has been widely used to detect inflammatory and malignant processes, to evaluate the extent of a malignancy, and to ascertain response to therapy. HOT *et al.* [3] reported diagnostic contribution of FDG-PET in patient with invasive fungal infection. More recently, VERONESI *et al.* [4] reported PET findings in the diagnostic work-up of screening-detected lung nodules. PET-computed tomography (CT) was highly sensitive for the differential diagnosis of indeterminate nodules detected at baseline, nodules ≥ 15 mm and solid nodules [4]. However, FDG-PET has never been evaluated in unselected patients with acute respiratory failure that complicates haematological malignancies.

We report the results from a prospective pilot study during which critically ill haematology patients with pulmonary infiltrates benefited from a FDG-PET in addition to routine diagnostic and therapeutic management. Diagnoses were made mostly by noninvasive tests and bronchoalveolar lavage (BAL) fluid analysis; in addition, six patients had bronchial or pulmonary biopsies. FDG-PET was performed between day 1 and day 5, and completed by two senior radiologists specialised in nuclear medicine. None of the patients was intubated at the time of PET-CT, and all received high flow oxygen or intermittent noninvasive mechanical ventilation. According to the level of maximum standardised uptake value (SUVmax), patients were classified as having normal (0–2), mild (2–4), moderate (4–8) or intense (>8) pulmonary parenchymal metabolic activity. Table 1 summarises individual demographic, clinical and FDG-PET data. No adverse effects were observed after isotope injection. Pulmonary lesion related to lymphoma and fungal or viral infection presented with moderate parenchymal activity, whereas bacterial pneumonia presented with focal and mild lung parenchymal activity. Intense lung parenchymal activity was observed with pulmonary tuberculosis (one patient) and pulmonary Kaposi sarcoma (two patients). Normal FDG-PET was associated with normal lungs but cardiac abnormalities (two patients).

The ability of lung PET-CT with a SUVmax >4 to detect pulmonary infiltration by the malignancy had a sensitivity of 100% and a specificity of 33.33%. Also, with a prevalence of malignant infiltration of 40%, the negative predictive value was 100% and the positive predictive value was 50%. Furthermore, the performances of lung PET-CT with a SUVmax >4 were identical than above to detect pulmonary infiltration by opportunistic infection (which prevalence was also 40%).

This preliminary evaluation of FDG-PET in haematology patients with acute respiratory failure depicts FDG-PET patterns that have not been previously reported. We are not able to provide a specific picture related to a single aetiology. However, since there is a direct relationship between diagnosis and prognosis in these patients [1], we believe that every emerging diagnostic strategy needs to be appraised and evaluated carefully to assess its possible contribution to diagnosis and treatments. Further description of FDG-PET patterns in unselected haematology patients with pulmonary involvement is warranted. This prospective evaluation may contribute to the identification of aetiology of pulmonary involvement, to report on the extent of the inflammatory or infectious process, and also to estimate diagnosis contribution of FDG-PET in patients not identified using conventional diagnostic methods. To do so, future studies will need to assess correlations with conventional CT and morphological and immunological features in cells recovered from BAL fluids. In this study of 20 patients, SUVmax was not correlated with the number and the type of BAL cells. Hence, diagnostic performance of lung PET-CT will need to be adjusted for accompanying inflammatory reaction in the normally aerated lung with respect to their neutrophil activation and on correlation of FDG-PET with conventional CT. Only such an evaluation would help determine whether PET-CT can replace conventional CT and bronchoscopy and BAL fluid cytological analysis. Last, patient follow-up using PET-CT may help correlate lung metabolic activity and respiratory situation, in order to assess whether patients are responsive to anti-inflammatory, anti-tumoural or anti-infectious agents.

In summary, these preliminary descriptive results provide interesting insights on the use of PET-CT in immunocompromised patients with pulmonary infiltrates. However, they raise more questions than they

TABLE 1 Clinical features, pulmonary diagnosis, ¹⁸F-fluorodeoxyglucose (FDG) positron emission tomography (PET) results and definite pulmonary diagnoses in patients with haematological malignancies and acute respiratory failure

Case	Gender, age years	Malignancy	Definite diagnosis	CT findings	BAL findings	FDG-PET findings	Diagnostic test
1	Male, 41	Haemophagocytic lymphohistiocytosis	Kaposi Sarcoma	Diffuse ground glass opacities	Alveolar haemorrhage	Diffuse and intense	Lung biopsy
2	Female, 73	Myelodysplasia	Kaposi Sarcoma	Peribronchovascular nodules, diffuse ground glass opacities	Increased number of BAL cells, 90% macrophages	Diffuse and intense	Bronchial biopsy
3	Female, 32	Hodgkin lymphoma	Tuberculosis	Segmental pneumonia	Increased number of BAL cells, 40% neutrophils, 30% lymphocytes	Focal and intense	Sputum
4	Male, 62	Chronic myelomonocytic leukaemia	Pulmonary infiltration from the malignancy	Centrolobular nodules	Alveolitis with 90% neutrophils and myelomonocytic cells	Diffuse and moderate	BAL
5	Male, 63	MALT lymphoma	Pulmonary infiltration from the malignancy	Diffuse ground glass opacities	Normal	Diffuse and moderate	Lung biopsy
6	Female, 54	Intravascular large B cell lymphoma	Pulmonary infiltration from the malignancy	Peribronchovascular nodules, localised ground glass opacities	Normal	Diffuse and moderate	Bronchial biopsy
7	Female, 28	Hodgkin lymphoma	Pulmonary infiltration from the malignancy	Diffuse ill-defined alveolar consolidation	Not performed	Diffuse and moderate	Marrow smear
8	Female, 59	MALT lymphoma	Pulmonary infiltration from the malignancy	Diffuse ground glass opacities	Normal	Diffuse and moderate	Lung biopsy
9	Female, 54	Diffuse large B cell lymphoma	Pulmonary infiltration from the malignancy	Peribronchovascular nodules	Alveolitis, tumoral B-cell infiltration	Diffuse and moderate	BAL
10	Male, 70	Pleiomorph NHT lymphoma	Pneumocystis	Diffuse ground glass opacities	Not performed	Diffuse and moderate	Sputum
11	Male, 62	Chronic lymphoid leukaemia	Pneumocystis	Diffuse ground glass opacities	Increased number of BAL cells, 80% lymphocytes	Diffuse and moderate	BAL
12	Male, 47	Burkitt lymphoma	Invasive aspergillosis	Diffuse ill-defined alveolar consolidation	Not performed	Diffuse and moderate	Circulating galactomannan and sputum Biopsy
13	Male, 12	Acute myeloid leukaemia	Zygomycete pneumopathy	Ill-defined consolidation, halo sign	Necrotic cells	Focal and moderate	BAL
14	Female, 49	Follicular lymphoma	Geotrichum pneumopathy	Not performed (severe ARDS)	Normal cells	Focal and moderate	BAL
15	Male, 46	Mantle lymphoma	Invasive aspergillosis	Not performed	Not performed	Diffuse and moderate	Circulating galactomannan
16	Male, 68	Diffuse large B cell lymphoma	Viral infection	Diffuse ground glass opacities	Not performed	Diffuse and moderate	Nasopharyngeal aspirate
17	Male, 71	Myelodysplastic syndrome	Bacterial pneumonitis	Not performed	Not performed	Focal and mild	CT scan
18	Female, 73	Chronic myelomonocytic leukaemia	Bacterial pneumonitis	Not performed	Not performed	Focal and mild	CT scan
19	Male, 63	Chronic myeloid leukaemia	Cardiogenic pulmonary oedema	Not performed	Not performed	Normal	Echocardiography
20	Male, 80	Chronic lymphoid leukaemia	Patent foramen ovale with anatomic shunt	Normal	Not performed	Normal	Contrast echocardiography

CT: computed tomography; BAL: bronchoalveolar lavage; MALT: mucosa-associated lymphoid tissue; NHT: non-Hodgkin lymphoma; ARDS: acute respiratory distress syndrome. Parenchymal PET metabolic activity (maximum standardised uptake value): normal 0–2, focal and mild 2–4, moderate 4–8, intense >8.

bring answers. Studies are needed to confirm these results on a larger scale. Also, investigations to assess diagnostic performance of PET-CT as compared to a well-accepted gold standard, such as pulmonary biopsy, are warranted.



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Lung FDG-PET may help to identify aetiology of pulmonary infiltrates in immunocompromised patients <http://ow.ly/S24gC>

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References

- 1 Azoulay E, Mokart D, Lambert J, *et al.* Diagnostic strategy for hematology and oncology patients with acute respiratory failure: randomized controlled trial. *Am J Respir Crit Care Med* 2010; 182: 1038–1046.
- 2 Azoulay E, Schlemmer B. Diagnostic strategy in cancer patients with acute respiratory failure. *Intensive Care Med* 2006; 32: 808–822.
- 3 Hot A, Maunoury C, Poiree S, *et al.* Diagnostic contribution of positron emission tomography with [18F] fluorodeoxyglucose for invasive fungal infections. *Clin Microbiol Infect* 2011; 17: 409–417.
- 4 Veronesi G, Travaini LL, Maisonneuve P, *et al.* Positron emission tomography in the diagnostic work-up of screening-detected lung nodules. *Eur Respir J* 2015; 45: 501–510.

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