Clinical and Translational Imaging (2021) 9:551–552
https://doi.org/10.1007/s40336-021-00449-6

SPOTLIGHT

Should FDG PET/CT or PET/MR replace WBC scan in infectious and inflammatory disease?

Luca Burroni[1] · **Laura Evangelista**[2]

Received: 10 June 2021 / Accepted: 5 July 2021 / Published online: 10 July 2021

The diagnosis of infections is made by the isolation of the pathogen by microbiological assays. However, biopsy is an invasive procedure, and its findings depend on the quality of the sample. Clinical examination and biochemical inflammatory markers are often non-specific and do not allow a differentiation between infection and inflammation.

Nuclear medicine has at disposal diverse conventional techniques able to evaluate infections, including radiolabeled white blood cell (WBC) scintigraphy (with or without combined bone marrow scan) and anti-granulocyte antibody scintigraphy. However, some limitations for them have been reported. First, in vitro leukocyte labeling process requires skilled personnel, is laborious and is not always available. Second, the radiolabeling of leukocytes involves the direct manipulation of blood products that can be linked to some specific risks [1]. Third, patients have to come for two consecutive days, and the count statistic detected with leukocyte scintigraphy is weak in the images 24 h after injection. Finally, complementary bone marrow imaging is usually required to improve accuracy. Not surprisingly, alternative radiopharmaceuticals have been continuously studied, such as radiolabeled anti-granulocyte antibodies, antibody fragments, the avidin–biotin complex, radiolabeled synthetic fragments of Ubiquicidin, for improving the performance of imaging techniques [2].

^{18}F-FDG PET is able to identify sites of inflammation and infection by detecting the glycolytic and metabolic activity of the cells involved in the inflammatory process. It offers several advantages over leukocyte scintigraphy because it is more convenient for the patient, its availability in larger hospitals, a simple protocol and a high spatial resolution, no cell labeling is required, and the whole procedure takes less than 2 h. Furthermore, the daily use of PET/CT has increased over time with a significant saving in the cost of radiopharmaceuticals and healthcare personnel employed. In recent years, the commercial cost of a single labeled leukocyte exam has increased and the commercial cost of a single PET/CT with FDG has decreased. As stated by Dibble et al., the cost of a single dose of labeled leukocytes could be as much as 8–10 times the cost of a single dose of FDG [3]. However, also FDG PET/CT has some limitations. First, the radiation dose. A whole-body PET/CT examination entails approximately 14 mSv, whereas a labeled leukocyte scan entails approximately 7–8 mSv. Adding SPECT/CT increases the dose of a labeled leukocyte examination to approximately 13 mSv [4, 5]. Second, with PET/CT is difficult to distinguish sterile inflammation from inflammation caused by infection. Finally, the optimal timing between FDG PET/CT and surgery for the definition of infective foci, due to the absorption of FDG in postoperative tissue inflammation.

Therefore, some clinical situations (i.e., in case of artificial devices that can alter the interpretation or corrected PET images, such as cardiovascular or orthopedic prostheses) may be solved using leukocyte scintigraphy, but PET/CT would be preferable in hospitalized patients. Especially when the clinical issue is an infection of unknown origin. In this regard, some available data in patients with fever of unknown origin and bacteremia have demonstrated that PET/CT with FDG is an inexpensive imaging technique because it can avoid unnecessary investigations and reduce the length of hospitalization [6].

In summary, some considerations should influence the choice of an imaging modality in patients with infectious and inflammatory diseases, such as the availability, the radiation dose, the safety, the examination time, legal/organizational/economic aspects and finally the cost-effectiveness. Furthermore, the opportunity to use a PET/MRI scanner in this clinical setting seems very promising, although further evidence-based scientific studies are still needed.

✉ Luca Burroni
luca.burroni@ospedaliriuniti.marche.it

[1] Department of Nuclear Medicine, "Ospedali Riuniti di Torrette" Hospital of Ancona, Via Conca 71, Ancona, Italy

[2] Nuclear Medicine Unit, Department of Medicine DIMED, University of Padova, Padova, Italy

Declarations

Conflicts of interest The authors declare no conflict of interest.

Human and animal rights The present manuscript does not involve human participants.

Informed consent The present manuscript does not require an informed consent collection.

References

1. Callahan RJ, Chilton HM, Ponto JA et al (2007) Procedure guideline for the use of radiopharmaceuticals. J Nucl Med Technol 35:272–275
2. Salmanoglu E, Kim S, Thakur ML (2018) Currently available radiopharmaceuticals for imaging infection and the holy grail. Semin Nucl Med 48:86–99
3. Dibble EH, Yoo DC, Baird GL et al (2019) FDG PET/CT of infection: should it replace labeled leukocyte scintigraphy of inpatients? AJR 213:1358–1365
4. Censullo A, Vijayan T (2017) Using nuclear medicine imaging wisely in diagnosing infectious diseases. Open Forum Infect Dis 4:1–7
5. Larkin AM, Serulle Y, Wagner S et al (2011) Quantifying the increase in radiation exposure associated with SPECT/CT compared to SPECT alone for routine nuclear medicine examinations. Int J Mol Imaging 2011:897202
6. Balink H, Tan SS, Veeger NJGM et al (2015) 18F-FDG PET/ CT in inflammation of unknown origin: a cost-effectiveness pilot-study. Eur J Nucl Med Mol Imag 42:1408–1413