FDG uptake in marrow and spleen: What does it mean?

Importance of clinical context in the interpretation of FDG uptake in marrow and spleen in infective endocarditis

Asbjørn M. Scholtens, MD,^a and Hein J. Verberne, MD, PhD^b

^a Department of Nuclear Medicine, Meander Medical Center, Amersfoort, The Netherlands

^b Department of Radiology and Nuclear Medicine, Amsterdam University Medical Centers, Location AMC, University of Amsterdam, Amsterdam, The Netherlands

Received Feb 25, 2020; accepted Feb 25, 2020

doi:10.1007/s12350-020-02095-3

See related article, pp. 2533–2542

Infective endocarditis (IE) is a life-threatening disease with high morbidity and mortality, and its treatment involves prolonged antibiotic therapy or even surgical intervention. A correct and timely diagnosis is crucial, and positron emission tomography/computed tomography (PET/CT) with ¹⁸F-fluorodeoxyglucose (FDG) has come to play an increasingly accepted role in this setting in recent years, most notably in the context of cardiac implants such as prosthetic heart valves, pacemakers, and defibrillators. Although FDG PET/CT has proven itself an accurate technique in prosthetic heart valve endocarditis especially,^{1,2} distinguishing between non-infectious inflammation and infection requires expertise.³ Conversely, vegetations without paravalvular complications may be false negative and require other techniques such as echocardiography or CT angiography to assess.⁴

As FDG PET/CT allows for imaging of the entire body in a single session, secondary findings related to and supporting the diagnosis of IE may also be encountered. For example, metastatic infectious foci

may further support the diagnosis, even in the absence of clear foci in the heart.⁵

In their paper, Boursier et al. describe another secondary finding in the form of hypermetabolism of the spleen and/or bone marrow (HSBM).⁶ Both play a role in the immune response,^{7,8} so it is perhaps no surprise that they found a link between the presence of IE and an activation of these tissues. In their cohort of 129 patients with a definite diagnosis of IE in 88, HSBM was a predictor of definite IE. It was especially powerful when combined with cardiac foci, associated with a definite diagnosis of IE in 29 out of 30 patients and probable IE in the final patient.

However, as Boursier et al. point out, these findings are at least partially influenced by their specific patient group with an exceptionally high prevalence of IE, and their results must therefore be read in this particular context. Even in the group with no cardiac, bone marrow, or spleen abnormalities, more than a third of the patients had IE.

In a less selected population, the number of reasons for HSBM is more varied and it is vital for reading physicians to be aware of patient- or treatment-related factors that may influence these findings even outside the setting of infection. Figure 1 shows four examples of scans with HSBM that were not related to infection, ranging from anemia to chemotherapy. Anemia especially is a common enough finding that must be considered when bone marrow is deemed to be more active than normal. Additionally, as the presenting symptoms of IE are non-specific including fever and malaise, other diseases that show increased bone

Reprint requests: Asbjørn M. Scholtens, MD, Department of Nuclear Medicine, Meander Medical Center, Amersfoort, The Netherlands; a.scholtens@meandermc.nl

J Nucl Cardiol 2021;28:2543–4.

1071-3581/\$34.00

Copyright © 2020 American Society of Nuclear Cardiology.

Figure 1. Four patients with non-infectious bone marrow (A–D) and spleen (B–D) hypermetabolism on FDG PET/CT. **A** patient scanned for suspicion of lung malignancy. No malignancy was found, and bone marrow hypermetabolism was explained by anemia. **B** patient presenting with fever. Cause for the bone marrow and spleen activation was determined to be an auto-immune hemolytic anemia. **C** patient treated with granulocyte colony-stimulating factor. **D** patient treated with chemotherapy for B cell lymphoma. Full remission of the lymphoma with chemotherapy-induced hypermetabolism of the bone marrow and spleen. No evidence of endocarditis in any of these patients.

marrow uptake such as leukemia⁹ may certainly present in a similar fashion.

It remains to be seen if HSBM would remain a significant independent predictor of IE in a more varied setting with different pathologies more commonly encountered in daily routine. Nevertheless, the paper by Boursier et al. shows that in patients with HSBM and cardiac foci, the diagnosis of IE is extremely likely. In the absence of cardiac foci, the nature of HSBM is perhaps, as most things in life, often a matter of context.

References

1. Pizzi MN, Roque A, Fernandez-Hidalgo N, Cuellar-Calabria H, Ferreira-Gonzalez I, Gonzalez-Alujas MT, et al. Improving the diagnosis of infective endocarditis in prosthetic valves and intracardiac devices with 18F-fluorodeoxyglucose positron emission tomography/computed tomography angiography: Initial results at an infective endocarditis referral center. *Circulation* 2015;132:1113-26.
2. Swart LE, Gomes A, Scholtens AM, Sinha B, Tanis W, Lam MGEH, et al. Improving the diagnostic performance of (18)F-fluorodeoxyglucose positron-emission tomography/computed tomography in prosthetic heart valve endocarditis. *Circulation* 2018;138:1412-27.
3. Pizzi MN, Roque A, Cuellar-Calabria H, Fernandez-Hidalgo N, Ferreira-Gonzalez I, Gonzalez-Alujas MT, et al. 18F-FDG-PET/CTA of prosthetic cardiac valves and valve-tube grafts: Infective versus inflammatory patterns. *JACC Cardiovasc Imaging* 2016;9:1224-7.
4. Scholtens AM, Swart LE, Verberne HJ, Tanis W, Lam MG, Budde RP. Confounders in FDG-PET/CT imaging of suspected prosthetic valve endocarditis. *JACC Cardiovasc Imaging* 2016;9:1462-5.
5. Mikail N, Benali K, Mahida B, Vigne J, Hyafil F, Rouzet F, et al. (18)F-FDG-PET/CT imaging to diagnose septic emboli and mycotic aneurysms in patients with endocarditis and cardiac device infections. *Curr Cardiol Rep* 2018;20:14.
6. Boursier C, Duval X, Mahida B, Hoen B, Goehringer F, Selton-Suty C, et al. Hypermetabolism of the spleen or bone marrow is an additional albeit indirect sign of infective endocarditis at FDG-PET. *J Nucl Cardiol*. 2020. <https://doi.org/10.1007/s12350-020-02050-2>.
7. Glatman Zaretsky A, Engiles JB, Hunter CA. Infection-induced changes in hematopoiesis. *J Immunol* 2014;192:27-33.
8. Bronte V, Pittet MJ. The spleen in local and systemic regulation of immunity. *Immunity* 2013;39:806-18.
9. Arimoto MK, Nakamoto Y, Nakatani K, Ishimori T, Yamashita K, Takaori-Kondo A, et al. Increased bone marrow uptake of 18F-FDG in leukemia patients: Preliminary findings. *Springerplus*. 2015;4:521.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.