# Systemic Immune Response Syndrome After COVID-19 Immunization—Initial and Follow-up $^{18}$F-FDG PET/CT Imaging Appearances

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**Abstract:** A 46-year-old woman with previous history of breast cancer had follow-up $^{18}$F-FDG PET/CT 5 days after COVID-19 vaccination. In addition to avid axillary nodes, a well-documented feature, the scan demonstrated diffuse splenic and marrow uptake. Clinical history, laboratory, and scan findings were in keeping with SIRS (systemic inflammatory response). The patient recovered with supportive management. On follow-up, $^{18}$F-FDG PET/CT imaging 3 months later features had resolved. SIRS after vaccination may be observed on $^{18}$F-FDG PET/CT.

**Key Words:** COVID-19 vaccination, $^{18}$F-FDG PET/CT, systemic immune response, splenic uptake, marrow uptake

(*Clin Nucl Med* 2022;47: e327–e328)

Received for publication September 29, 2021; revision accepted October 23, 2021.

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Conflicts of interest and sources of funding: none declared.

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ISSN: 0363-9762/22/4703–e327
DOI: 10.1097/RLU.0000000000004032

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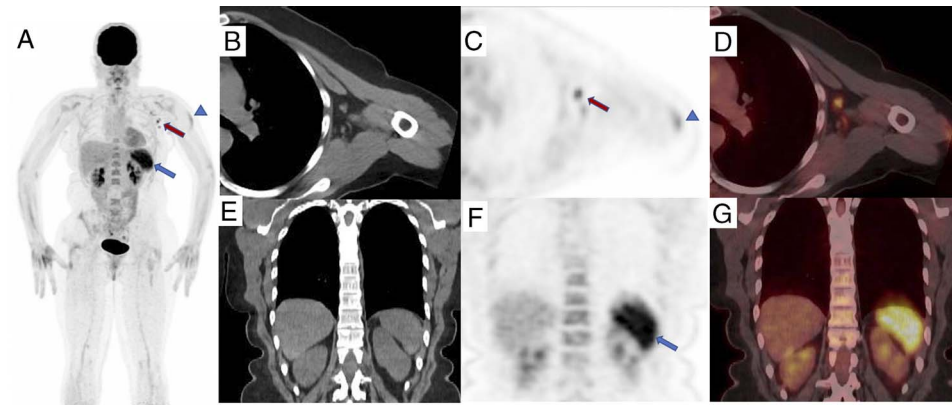


**FIGURE 1.** A 46-year-old woman with history of metastatic breast cancer in complete remission and maintenance hormonal therapy for 7 years presented with new left hip pain. No abnormalities were found on conventional imaging, and an $^{18}$F-FDG PET/CT was arranged to assess for recurrent disease. A "skull vertex to knees" scan was performed: MIP (**A**), axial CT, $^{18}$F-FDG PET, and fused $^{18}$F-FDG PET/CT of the left hemithorax and upper arm (**B**–**D**), and coronal CT, $^{18}$F-FDG PET, and fused $^{18}$F-FDG PET/CT of the chest and abdomen (**E**–**G**), which demonstrate avid small volume left axillary nodes (red arrows), focal uptake in the left upper arm/left deltoid (arrowhead), and diffuse splenic uptake (blue arrows). No abnormal uptake at the left hip, but diffuse mild marrow uptake (**A**) is likely reactive. Focal photopenia at L3 correlates to an old, healed metastasis. The patient had received her first dose of ChAdOx1 nCoV-19 (Oxford-AstraZeneca) vaccination in the left upper arm 5 days earlier. Focal uptake in the left upper arm/deltoid most correlates to the injection site, and the avid small volume left axillary nodes are in keeping with being reactive. These vaccine-associated reactive findings are well documented.[1–6] Physiological splenic uptake is expected to be similar or less to liver background.[7] Elevated diffuse splenic and bone marrow uptake may be seen in a number of scenarios, such as iatrogenic (eg, granulocyte colony-stimulating factor), anemia, or systemic inflammatory/infectious diseases.[8–10] The patient was unwell the day after vaccination, presenting with persistent high fever. Iatrogenic causes were excluded. She was admitted for observation, investigations, and supportive treatment. Persistent fever was recorded at 38.4°C, mild tachycardia (99 beats per minute), and lymphopenia (3200/mm$^3$), criteria in support of systemic inflammatory response syndrome (SIRS). Sepsis was excluded by negative serial blood cultures. The patient recovered on supportive treatment. The presentation and $^{18}$F-FDG PET/CT findings were in keeping with vaccination-related SIRS. A similar case was described with influenza vaccination in 2016 and very recently with an m-RNA COVID-19 and Oxford-AstraZeneca COVID-19 vaccinations.[10–12]

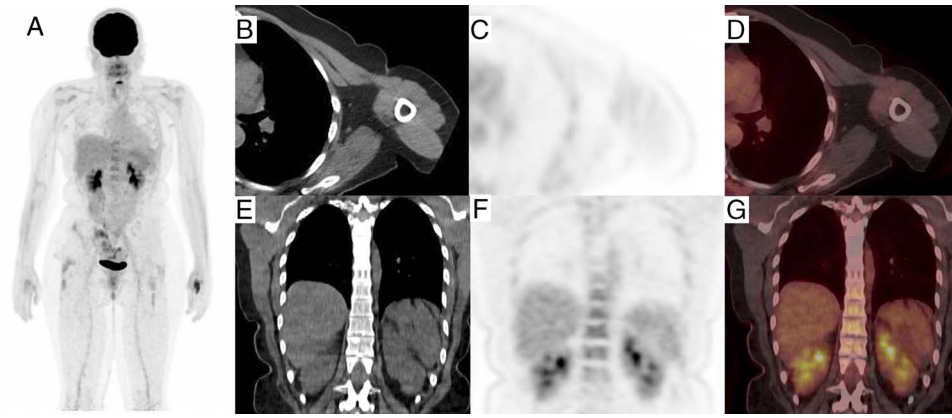


**FIGURE 2.** A follow-up $^{18}$F-FDG PET/CT was performed 3 months later: MIP (**A**), axial CT, $^{18}$F-FDG PET, and fused $^{18}$F-FDG PET/CT of the left hemithorax and upper arm (**B**–**D**), and coronal CT, $^{18}$F-FDG PET, and fused $^{18}$F-FDG PET/CT of the chest and abdomen (**E**–**G**); the small volume avid left axillary nodes, left deltoid uptake, and diffuse splenic and marrow uptake have resolved, consistent with the working diagnosis of SIRS related to COVID-19 vaccination. Although not a common response to vaccination, given the world wide mass immunization programs and the potential of recurrent seasonal boosters, SIRS may be observed with increasing frequency on $^{18}$F-FDG PET/CT. In conjunction with the appropriate clinical history and laboratory findings, the diagnosis of SIRS should be considered if FDG uptake is demonstrated in the superficial aspect of the deltoid muscle, ipsilateral axillary nodes, and diffusely within the spleen and bone marrow.