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Atypically Intense Pharmacologically Induced Brown Fat Activation on FDG PET/CT

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Abstract: Brown fat activation with increased radiotracer localization on FDG PET/CT studies is a well-known phenomenon. Activated brown adipose tissue (BAT) is usually seen in the supraclavicular region, but also in paraspinal and rarely in upper abdominal fat. Ours is a unique case of atypically intense, multilobular FDG uptake in activated BAT. Chart review revealed that the patient was receiving mirabegron, a known activator of brown fat. Methods of reducing brown fat uptake are known, but little information is reported on pharmacologic causes of increased uptake. Factors increasing FDG uptake in BAT should also be considered when interpreting PET/CT studies.

Key Words: brown fat activation, mirabegron, FDG, lymphoma, PET/CT

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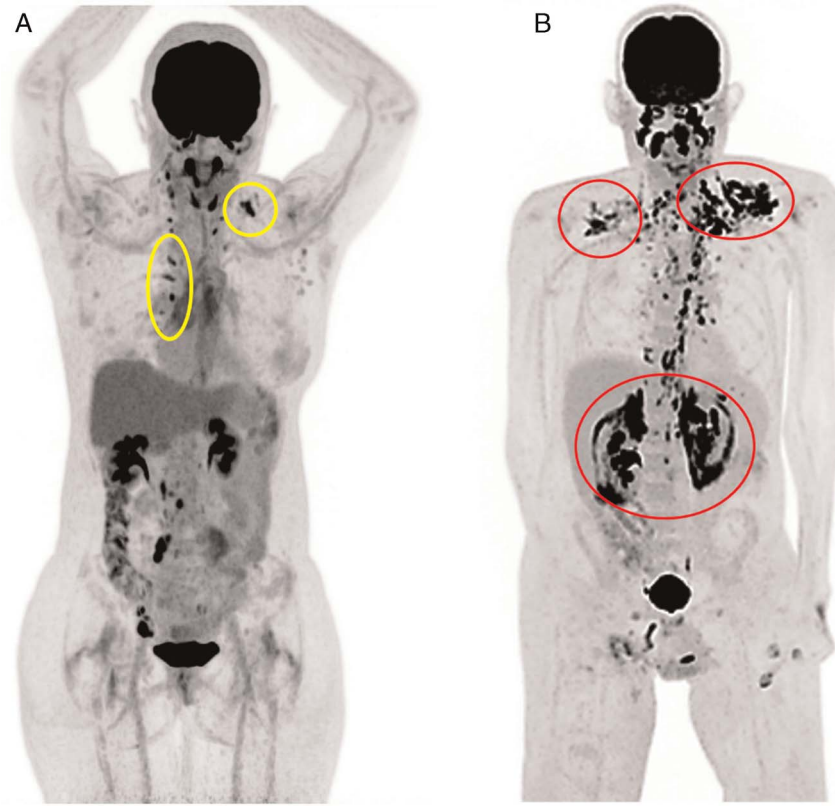

FIGURE 1. A 47-year-old quadriplegic man underwent a PET/CT study with ^{18}F-FDG for evaluation of a lumbar spine soft tissue anomaly seen on MRI. The FDG PET/CT showed intense, multilobular uptake in the supraclavicular region, with additional intense uptake in paraspinal and perinephric fat. Accumulation of FDG in activated brown adipose tissue (BAT) is a well-known phenomenon due to underlying high glucose metabolism for thermogenesis.[1] BAT is predominantly located in the cervical, supraclavicular, and paraspinal regions, with some abdominal involvement also reported.[2] Although FDG uptake in BAT is sporadic and typically only mildly hypermetabolic as exemplified in the MIP image from another patient (**A**), our patient's FDG PET MIP image showed more extensive distribution, including markedly intense FDG uptake in the retroperitoneal and perirenal fat (**B**).

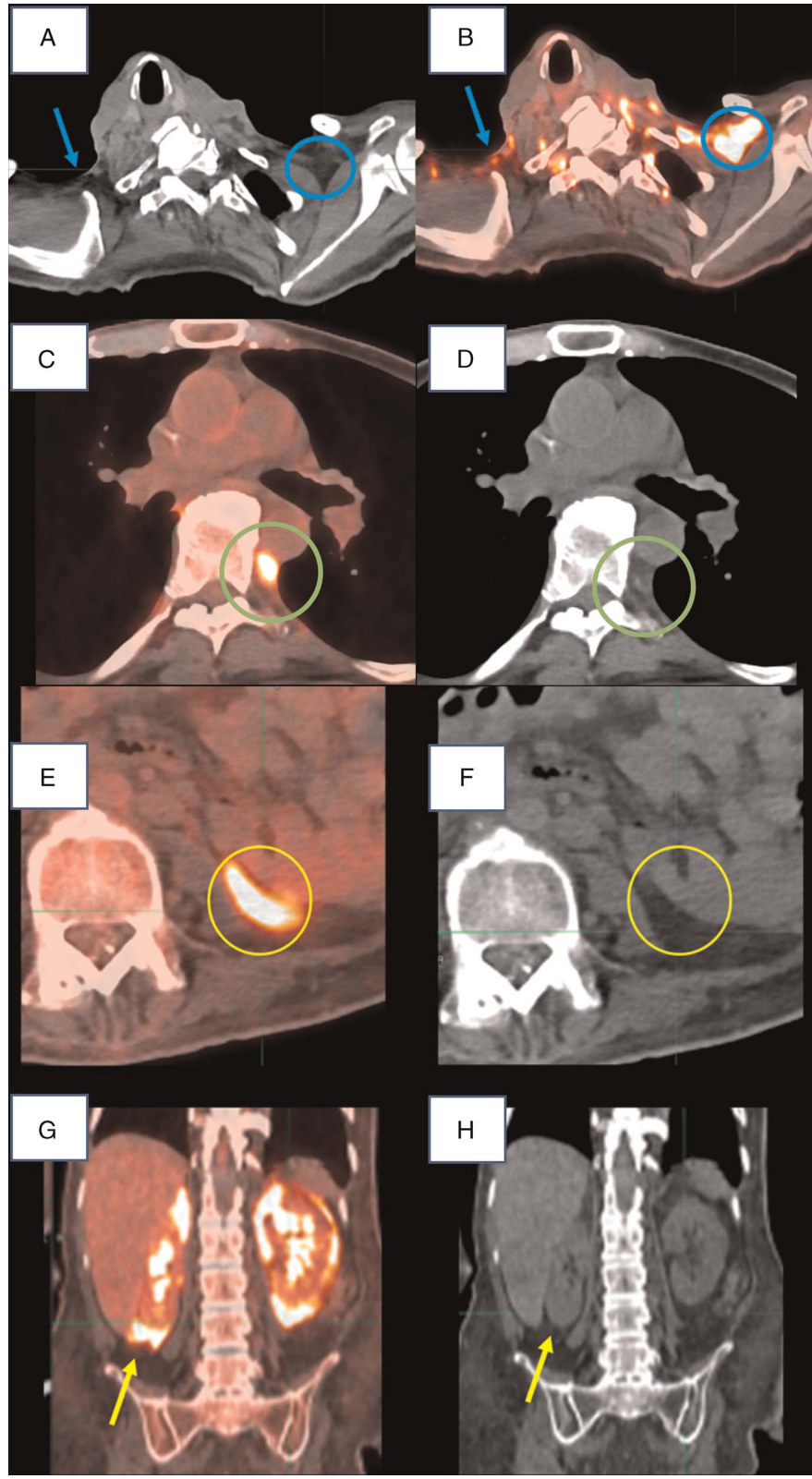

FIGURE 2. On cross-sectional imaging, the extensive FDG uptake localized to subcutaneous fat in the expected locations, including supraclavicular (**A** and **B**) and paraspinal regions (**C** and **D**).[3] In addition, evident on both transverse and coronal orientations (**E**–**H**) was substantially increased uptake in the retroperitoneum including perirenal fat, which is rarely reported. Markedly intense perinephric FDG uptake can be seen in other entities such as lymphoma or Erdheim-Chester disease.[4,5]

However, in the corresponding CT images, the increased FDG uptake was centered on the fatty tissue not renal parenchyma, effectively excluding those possibilities. A chart review prompted by the atypically intense uptake revealed that the patient was receiving mirabegron (Myrbetriq) for bladder dysfunction in the setting of quadriplegia. Mirabegron is a B3-adrenergic antagonist that activates BAT, most likely resulting in this substantial increase in FDG uptake.[6] Based on known seasonal variations in FDG uptake in BAT, the expected range for SUV_{max} in the supraclavicular and paraspinal region is 2 to 10.[7] Semiquantitative analysis confirmed the comparatively atypically high SUV_{max} for our patient, 29.3 for supraclavicular and 21 for paraspinal region, respectively. The perinephric SUV_{max} was 26.8. For further correlation, we measured the brown fat FDG uptake in 6 patients undergoing PET at our institution, contemporaneous to the index case (June–August). The average SUV_{max} for this group was 7.5 for the supraclavicular and 8.4 for the paraspinal region, respectively, matching the published values. Being a young female, having lower body mass index, and colder temperatures are known factors that increase FDG uptake in BAT.[1,7,8] More attention has been focused on the reduction of FDG uptake in brown fat. This is achieved primarily through temperature control, for example, keeping the patient warm during FDG uptake. Pharmaceutical intervention such as beta-blockers and diazepam has been used, although the efficacy of diazepam is disputed.[1] Increased FDG uptake in brown fat likely due to mirabegron has been described before[9]; we further explored and solidified this phenomenon with semiquantitative analysis in this case. Because increased uptake can lead to false-positive diagnoses as described, this case highlights the importance of being cognizant of the impact of medications that may actually increase the FDG uptake when interpreting FDG PET/CT studies.