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Case Report

White adipose tissue uptake on ^{18}F FDG PET/CT: A case report ☆

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ABSTRACT

Three distinct types of adipose tissue have been characterized: brown, white, and beige. Brown adipose tissue (BAT) is typically found in specific regions including the anterior cervical, supraclavicular, axillary, and paravertebral areas. White adipose tissue (WAT) predominantly resides in subcutaneous layers, intramuscular spaces and among visceral organs, while beige adipose tissue is a subtype of WAT and is found interspersed within WAT deposits. BAT displays metabolic activity detectable on PET/CT scans, in contrast to WAT, which typically exhibits minimal to no uptake. Beige adipose tissue has been observed metabolically active in mice under certain conditions. Alterations in adipose tissue biodistribution are uncommon and have been linked to high-dose corticosteroid use. We present a rare case illustrating abnormal FDG uptake in WAT associated with high-dose corticosteroid therapy.

Introduction

Three types of adipose tissue have been described, brown, white, and beige [1]. Brown adipose tissue (BAT) can be found in the anterior cervical, supraclavicular, axillary, and paravertebral tissues [1]. White adipose tissue (WAT) can be found in the subcutaneous and visceral tissue, beige adipose tissue is a subtype of WAT and can be found in subcutaneous deposits of WAT [1]. White adipose tissue main function is to store energy, while brown adipose tissue regulates temperature [2]. Recent studies have found that beige adipocytes also play a role in regulating temperature but only when exposed to cold or certain substances [3].

Brown adipose tissue can have uptake on ^{18}F 2-fluoro-2-deoxyglucose (FDG) positron emission tomography/computer tomography (PET/CT) but white adipose tissue in normal conditions does not, meaning it is metabolically inactive [4]. As to beige adipose tissue it has only been metabolically active after chronic stimulation in mice [2]. In some instances, there has been an abnormal uptake on FDG PET/CT on WAT that has been associated to high-dose corticosteroid use [4,5]. We present a case of abnormal FDG white adipose tissue biodistribution associated to high-dose corticosteroid use.

☆ Competing Interests: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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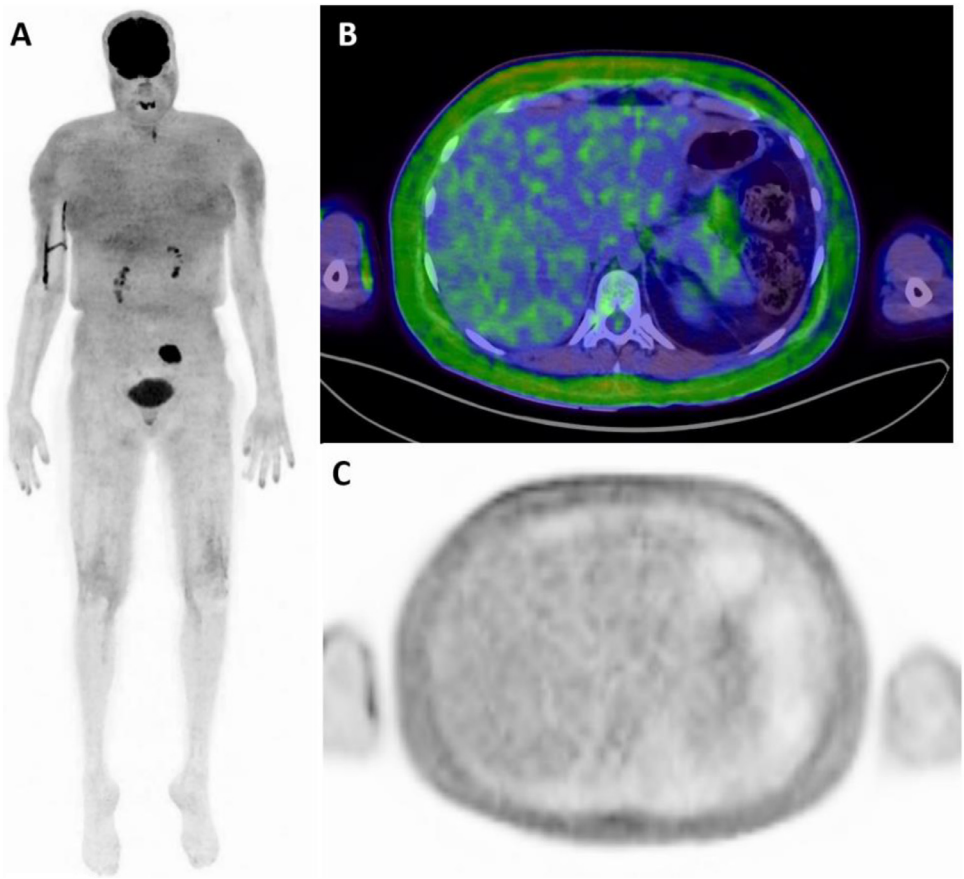

Fig. 1 – Initial staging FDG PET/CT scan. Images obtained 60 min after FDG was administered in the right arm. Blood glucose was 79 mg/dL at time of injection. (A) Maximum-intensity projection (MIP) image demonstrated altered radiotracer biodistribution in white adipose tissue predominantly in the upper torso. (B and C) Fused PET/CT (B) and attenuation corrected PET (C) at the level of the upper abdomen demonstrated increased uptake in the subcutaneous fat.

Case report

Patient is a 22 year-old female with recently diagnosed pulmonary blastoma who had undergone lobectomy in October of 2022. The patient had no prior medical or surgical history. In February of 2023 the patient was diagnosed with metastatic brain disease for which she was started on high-dose dexamethasone and chemotherapy. Two months after initiation of treatment patient presented for outpatient PET/CT for disease staging.

The patient fasted for more than 6 hours prior to obtaining the PET/CT scan, her blood glucose level was 79 mg/dL. Sixty minutes after FDG injection, the PET/CT scan demonstrated uptake in the subcutaneous WAT, particularly in the upper torso (Fig. 1). Increased uptake in the subcutaneous WAT had an SUV_{max} of 2.6; with lower uptake in the liver (SUV_{max} of 1.9) and aorta (SUV_{max} of 1.2).

This altered biodistribution impaired the diagnostic quality of the PET/CT scan and study was repeated after cessation of corticosteroids, repeated scan demonstrated resolved altered biodistribution (Fig. 2) making study optimal for disease staging.

Discussion

Three types of adipose tissue have been described, brown, white, and beige [1]. Brown adipose tissue can be found in the anterior cervical, supraclavicular, axillary, and paravertebral tissues [1]. White adipose tissue can be found under the dermis, intramuscular and between viscera [4], beige adipose tissue is a subtype of WAT and can be found in subcutaneous deposits of WAT [1]. White adipose tissue main function is to store energy, while brown adipose tissue is much more vascularized and regulates temperature [2,4]. Recent studies have found that beige adipocytes also play a role in regulating temperature but only when exposed to cold or certain substances [3].

It is well known that in some instances, BAT can be metabolically active which can be considered a normal variant, while WAT is metabolically inactive showing little to no glucose uptake during an FDG PET/CT study [4,5]. Regarding beige adipose tissue it has only been detected in mice after chronic stimulation within the inguinal regions with several modalities that have included FDG PET/CT, Xenon-enhanced CT and contrast-enhanced ultrasound [2].

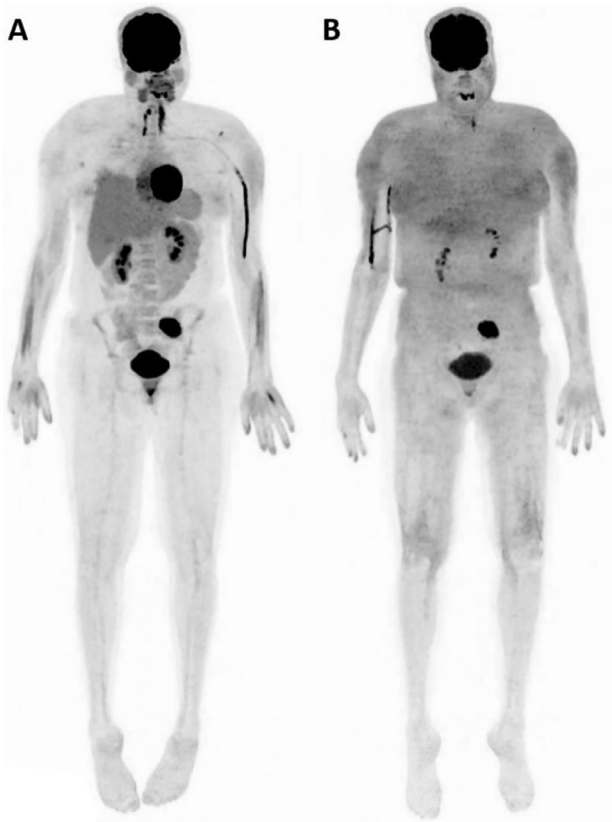

Fig. 2 – (A) Maximum-intensity projection (MIP) after corticosteroid cessation, demonstrated resolved altered radiotracer biodistribution in the white adipose tissue, with more conspicuous metastatic lesion in the left clavicle. (B) Initial MIP image with altered radiotracer biodistribution for comparison.

BAT uptake can be localized predominantly to the supraclavicular, axillary, and cervical regions, in comparison, WAT has been found to be localized more peripherally in the face and torso regions predominantly [4,6].

Elevated uptake in WAT is very rare (<1%), there is no gender or age predilection [4]. This phenomenon has been associated to medication, primarily high-dose corticosteroids used for chemotherapy, external steroid use, and secondarily to hypoglycemia [4]. This rare association has been attributed to the effect steroids have on catabolic lipolysis, anabolic lipogenesis, and adipogenesis, which consequently release free fatty acids and are pro-inflammatory, producing an increase in glycolytic metabolism in the mitochondria which can induce glucose uptake during FDG PET/CT studies [4–7]. This altered biodistribution can obscure active disease as there is decreased uptake in the blood pool, as seen on our case, and as thus, decreased uptake within the disease and its metastatic lesions [4].

Most reported cases with altered biodistribution of radiotracer have been linked to high-dose corticosteroid use, with resolution typically observed following cessation of medication. Additional causes, including exogenous corticosteroid use, anti-retroviral medications as well as herbal remedies, have been identified [4]. Despite diverse etiologies, altered biodistribution tends to manifest predominantly in subcutaneous and visceral fat deposits pertaining to WAT, often affecting regions such as the face, neck and back [4,6,7].

Our case elucidates the rarity of WAT uptake on PET/CT, primarily attributed to high-dose corticosteroid therapy. Corticosteroids induce metabolic alterations in adipose tissue, stimulate glycolytic metabolism and induce FDG uptake potentially resulting in decreased visualization of target lesions. Recognition of abnormal WAT uptake is crucial to prevent false-negative interpretations and ensure accurate disease assessment.

Patient consent

Complete written informed consent was obtained from the patient for the publication of this study and accompanying images.

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