Published in final edited form as:

Clin Nucl Med. 2015 September ; 40(9): 727–729. doi:10.1097/RLU.0000000000000851.

Assessing Cutaneous Psoriasis Activity Using FDG-PET:

Nonattenuation Corrected Versus Attenuation Corrected PET Images

Anshika Bakshi, BS^{*,†}, Saeid Gholami, MD[‡], Abass Alavi, MD, MD (Hon), DSc (Hon), PhD (Hon)[‡], Joel M. Gelfand, MD, MSCE[†], and Junko Takeshita, MD, PhD[†]

^{*}Robert Wood Johnson Medical School, Piscataway, NJ

[†]Department of Dermatology, Perelman School of Medicine, Philadelphia, PA

[‡]Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, PA

Abstract

Psoriasis is a chronic inflammatory skin condition characterized by well-circumscribed erythematous plaques with thick silvery scale. Infiltration of inflammatory cells such as lymphocytes, neutrophils, and macrophages and epidermal cell proliferation within psoriatic lesions may result in selective FDG accumulation. We present a 55-year-old patient with a 30-year history of psoriasis. Nonattenuation corrected PET/CT images demonstrated significant cutaneous FDG uptake corresponding to clinically apparent psoriatic lesions. However, in attenuation corrected (AC) FDG-PET images, the signal was substantially diminished and minimally detectable. Nonattenuation corrected FDG-PET images may be useful and preferable to AC images in assessing skin inflammation in psoriasis.

Keywords

Psoriasis; skin; fluorodeoxyglucose; positron emission tomography; non-attenuation corrected; attenuation corrected

Acknowledgments

Conflicts of interest and sources of funding: Funding sources include the National Heart Lung Blood Institute grant R01 HL111293 and National Institute of Arthritis and Musculoskeletal and Skin grant K24-AR064310 (Principal Investigator: Dr. Joel M. Gelfand), AbbVie Inc. grant to Dr Joel M. Gelfand, National Institutes of Health Training Grant 2T32 AR 7465–31 (Anshika Bakshi), and Dermatology Foundation Career Development Award (Dr. Junko Takeshita).

Financial disclosures: Dr. Gelfand served as a consultant for Abbvie, Amgen Inc., Celgene Corp, Eli Lilly, Merck, Janssen Biologics (formerly Centocor), Novartis Corp, and Pfizer Inc., receiving honoraria; had grants or has pending grants from Abbvie, Amgen Inc., Eli Lilly, Genentech Inc., Novartis Corp, and Pfizer Inc.; and received payment for continuing medical education work related to psoriasis. Dr. Takeshita has received payment for continuing medical education work related to psoriasis.

REFERENCES

1. Pariser DM, Bagel J, Gelfand JM, et al. National Psoriasis Foundation clinical consensus on disease severity. *Arch Dermatol.* 2007; 143:239–242. [PubMed: 17310004]
2. Carlin CS, Feldman SR, Krueger JG, et al. A 50% reduction in the Psoriasis Area and Severity Index (PASI 50) is a clinically significant endpoint in the assessment of psoriasis. *J Am Acad Dermatol.* 2004; 50:859–866. [PubMed: 15153885]
3. Schmitt J, Wozel G. The psoriasis area and severity index is the adequate criterion to define severity in chronic plaque-type psoriasis. *Dermatology.* 2005; 210:194–199. [PubMed: 15785046]
4. [Accessed January, 16 2014] Centocor: briefing document for ustekinumab (CNTO 1275). Food and Drug Administration. 2008 Jun 17. Available at <http://www.fda.gov/ohrms/dockets/ac/08/briefing/2008-4361b1-02-CENTOCOR.pdf>.
5. [Accessed January 16, 2014] Enbrel (etanercept) for the treatment of pediatric plaque psoriasis. Food and Drug Administration. 2008 Jun 18. Available at <http://www.fda.gov/ohrms/dockets/ac/08/briefing/2008-4361b2-01-FDA.pdf>.
6. Banzo J, Ubieta MA, Andres A, et al. The contribution of (1)(8)F-FDG PET/CT in a patient with cutaneous metastases of squamous cell carcinoma of the penis. *Rev Esp Med Nucl Imagen Mol.* 2014; 33:293–295. [PubMed: 24866051]
7. Huang Z, Qiu C, Guan Y. 18F-FDG imaging of a rare cutaneous infection by *Mycobacterium avium* complex. *Clin Nucl Med.* 2014; 39:301–304. [PubMed: 24445276]
8. Egan C, Silverman E. Increased FDG uptake along dermatome on PET in a patient with herpes zoster. *Clin Nucl Med.* 2013; 38:744–745. [PubMed: 23816943]
9. Makis W, Lisbona R. Aggressive variant of primary cutaneous anaplastic large T-cell lymphoma: a new role for 18F-FDG PET/CT. *Clin Nucl Med.* 2010; 35:598–600. [PubMed: 20631509]
10. Mitsuhashi K, Momose M, Masuda A, et al. Positron emission tomography revealed diffuse involvement of the lower legs and occult extracutaneous lesions in subcutaneous panniculitis-like T-cell lymphoma. *Clin Nucl Med.* 2013; 38:209–211. [PubMed: 23354029]
11. Bruna-Muraille C, Pochart JM, Papathanassiou D, et al. Incidental finding of F-18 FDG skin uptake in a patient with psoriasis during the evaluation of a recurrent papillary thyroid carcinoma. *Clin Nucl Med.* 2011; 36:34–35. [PubMed: 21157205]
12. Mehta NN, Yu Y, Saboury B, et al. Systemic and vascular inflammation in patients with moderate to severe psoriasis as measured by [18F]-fluorodeoxyglucose positron emission tomography-computed tomography (FDG-PET/CT): a pilot study. *Arch Dermatol.* 2011; 147:1031–1039. [PubMed: 21576552]
13. Takeshita J, Saboury B, Salavati A, et al. 18-Fluorodeoxyglucose positron emission tomography-computed tomography (FDG PET-CT) as a novel tool for quantification of psoriasis disease activity: Proof of concept from the Vascular Inflammation in Psoriasis (VIP) trial. *J Invest Dermatol.* 2013; 133:S177.
14. Tao J, Yang J, Wang L, et al. Expression of GLUT-1 in psoriasis and the relationship between GLUT-1 upregulation induced by hypoxia and proliferation of keratinocyte growth. *J Dermatol Sci.* 2008; 51:203–207. [PubMed: 18565734]
15. Imran MB, Kubota K, Yamada S, et al. Lesion-to-background ratio in nonattenuation-corrected whole-body FDG PET images. *J Nucl Med.* 1998; 39:1219–1223. [PubMed: 9669398]
16. Reinhardt MJ, Wiethoelter N, Matthies A, et al. PET recognition of pulmonary metastases on PET/CT imaging: impact of attenuation-corrected and non-attenuation-corrected PET images. *Eur J Nucl Med Mol Imaging.* 2006; 33:134–139. [PubMed: 16193313]
17. Schauwecker DS, Siddiqui AR, Wagner JD, et al. Melanoma patients evaluated by four different positron emission tomography reconstruction techniques. *Nucl Med Commun.* 2003; 24:281–289. [PubMed: 12612469]
18. Alavi A, Gupta N, Alberini JL, et al. Positron emission tomography imaging in nonmalignant thoracic disorders. *Semin Nucl Med.* 2002; 32:293–321. [PubMed: 12524653]
19. Bleckmann C, Dose J, Bohuslavizki KH, et al. Effect of attenuation correction on lesion detectability in FDG PET of breast cancer. *J Nucl Med.* 1999; 40:2021–2024. [PubMed: 10616880]

20. Houseni M, Chamroonrat W, Basu S, et al. Usefulness of non attenuation corrected 18F-FDG-PET images for optimal assessment of disease activity in patients with lymphoma. *Hell J Nucl Med*. 2009; 12:5–9. [PubMed: 19330173]

FIGURE 1.

A 55 year-old male patient with 30-year history of psoriasis treated with intermittent topical steroids until 2 weeks before PET-CT scan. The patient had severe psoriasis as indicated by 25% body surface area involvement, Psoriasis Area and Severity Index of 12.2, and Physician Global Assessment of 2.7 (induration, 2; erythema, 3; and scale, 3).¹⁻⁵ Patient's buttocks and posterior thighs show scattered psoriatic plaques. Black arrows point to clinically apparent psoriasis that showed FDG uptake in PET images. White arrows indicate areas without corresponding FDG uptake in PET images.

FIGURE 2.

Increased FDG uptake in the skin detected by nonattenuation corrected (NAC) PET images is visualized in the posterior view of the 3-dimensional maximum intensity projection (MIP) image (**AI**) as indicated by black arrows and in coronal (**AII**) and trans-axial views (**AIII**). Cutaneous FDG uptake is minimally detectable in the posterior view of the attenuation corrected (AC) MIP (**BI**), coronal (**BII**), and axial (**BIII**) images. Increased FDG uptake as seen in NAC images corresponds with many clinically apparent skin lesions. However, there are also visible psoriatic plaques that are not associated with detectable FDG uptake in either

corrected or uncorrected PET images (Fig. 1, white arrows). This discrepancy suggests limitations in the ability to identify active skin inflammation by clinical examination alone. Detection of cutaneous FDG uptake has been reported in cases such as squamous cell carcinoma,⁶ infection by *Mycobacterium avium* complex⁷ and herpes zoster,⁸ and variants of cutaneous T-cell lymphoma.^{9,10} Moreover, 2 reports have documented FDG uptake suggesting skin inflammation in psoriasis patients using AC FDG-PET images,^{11,12} and a single report has shown that the metabolic volume product of psoriatic lesions (the product of the mean standard uptake value [SUV] of all psoriatic lesions and total volume of psoriatic plaques [mL]) can be used to objectively quantify overall psoriasis activity as a biologic marker.¹³ As GLUT-1 has been reported to be upregulated in the epidermis of psoriatic lesions,¹⁴ FDG signal in psoriatic plaques may be attributable to uptake by proliferating keratinocytes in the epidermis in addition to inflammatory cells. The use of NAC FDG-PET images for identification of cutaneous inflammation has not been well described in the literature. Several studies report similar sensitivity between NAC and AC FDG-PET images for detection of various noncutaneous tumors.^{15–17} On the other hand, lung nodules,¹⁸ small pulmonary metastases of breast cancer,¹⁹ and superficial lymphoma²⁰ lesions have been suggested to be more readily detectable by NAC images than by AC images. This superiority of NAC over AC may be due to lower contrast in AC images, which can be attributed to noise from transmission measurement, inhomogeneity of data transmission, and patient motion between emission and transmission scans.²⁰ In our case report, we show that cutaneous inflammation in patients with psoriasis may be detected by FDG-PET imaging and suggest that NAC PET images may prove to be superior to AC images in identifying actively inflamed psoriatic skin lesions.