^{18}F-FDG Uptake to Assess Eosinophilic Inflammation in Asthma: Would SUV at Late Imaging Be Relevant?

TO THE EDITOR: We read with great interest the article by Harris et al. (*1*) demonstrating that ^{18}F-FDG uptake rate (K_i, min^{-1}) precisely predicts the degree of eosinophilic inflammatory response in the lungs of asthmatic patients undergoing an allergen challenge. Any result in this field is of tremendous interest because it may provide complementary quantitative insight into the severity of the inflammatory response in asthma and thus may be used for testing innovative therapies. The study of Harris et al. used the gold standard graphical method of Patlak et al. involving dynamic acquisition until about 60 min after injection and venous blood sampling (*2,3*), allowing determination of the ratio of K_i in allergen-challenged and diluent-control lobe, which was compared with that of eosinophil counts obtained with bronchoalveolar lavage.

Because we have proposed an adapted estimation of ^{18}F-FDG metabolism that can be used for lung examination in clinical practice (*4*), we suggest that the standardized uptake value (SUV) assessed at late imaging may be used to estimate eosinophilic inflammation in asthma. Let us consider SUV at a late imaging time of $t > 60$ min:

$$SUV(t) = A_{Trap}(t)W/A_{Inj}, \qquad \textbf{Eq. 1}$$

where $A_{Trap}(t)$ ($kBq \cdot mL^{-1}$) is the trapped ^{18}F-FDG activity per tissue unit volume for free tracer in blood and interstitial volume can be neglected at late imaging (*5*), A_{Inj} is the injected activity, and W is the patient's weight. The former activity can also be derived from a compartmental model analysis as (*4*):

$$A_{Trap}(t) = K_i\, A_{Inj}\, f(t), \qquad \textbf{Eq. 2}$$

where f(t) is a function involving ^{18}F-FDG input function parameters. Therefore, combining Equations 1 and 2 provides the following expression for SUV that now involves K_i:

$$SUV(t) = Ki\ f(t)\ W, \qquad \textbf{Eq. 3}$$

As a consequence, the ratio of SUV and K_i in allergen-challenged and diluent-control lobe (subscripts 1 and 2, respectively) is the same because f(t) and W are the same:

$$SUV_1(t)/SUV_2(t) = K_{i1}/K_{i2}. \qquad \textbf{Eq. 4}$$

Harris et al. (*1*) found that the latter ratio was strongly correlated with eosinophil count ratio ($P < 0.001$). Furthermore, it should be emphasized, first, that correction for ^{18}F physical decay usually applied to SUV is cancelled out in the former ratio; second, that the use of mean SUV over lung lobe area (or volume) reduces variability in comparison with that of maximal SUV; and importantly, third, that assessing SUV ratio instead of K_i ratio avoids a time-consuming dynamic acquisition and invasive blood sampling.

In conclusion, the method of Harris et al. (*1*) clearly demonstrates that PET of ^{18}F-FDG uptake rate K_i may serve as a reliable biomarker of eosinophilic inflammation and its functional effects in asthma. In that framework, the current model analysis further suggests that simple SUV may play a similar role when assessed at late imaging. Analysis of SUV data obtained from the last dynamic frames in the study of Harris et al. would give some indication as to whether this suggestion may be tested in a clinical study.

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REPLY: We appreciate Drs. Laffon and Marthan's interest in our article relating with high precision the allergen-to-diluent ratio of the ^{18}F-FDG uptake rate (K_i) to the allergen-to-eosinophil count. They wonder if the ratio of late SUV might also closely correlate with the ratio of eosinophil count. To examine this possibility, we reanalyzed our data using the last 10-min frame of our dynamic acquisition to calculate both a mean and a peak standardized uptake value (SUV) in the regions of interest for the right middle lobe (allergen) and right upper lobe (diluent). We plotted the allergen-to-diluent ratio of mean and peak SUV against the ratio of eosinophil counts and found coefficients of determination of 0.3944 ($P = 0.18$) and 0.0015 ($P = 0.94$), respectively, compared with 0.9917 ($P < 0.001$) for the ^{18}F-FDG K_i ratio (*1*).

The reason for the marked difference in performance between SUV and K_i is unclear but may be due to the assumption that plasma activity is low in relation to tissue activity when SUV is calculated. Since SUV is the sum of both plasma activity and uptake, the ratio of SUV in the allergen-to-diluent regions of interest can closely approximate the ratio of K_i only when plasma activity is low relative to activity taken up by the tissue. In most organs, plasma