

Dynamic PET/CT with ^{11}C -Acetate in Prostate Cancer

TO THE EDITOR: In the April 2012 issue of *The Journal of Nuclear Medicine*, Mena et al. (1) reported on PET/CT studies using ^{11}C -acetate in localized prostate cancer. This was an interesting article, in which our work from 2008 (2) was quoted several times.

The prostate acetate uptake curves shown in Figure 1 of their article are strikingly different from what we have demonstrated. We have never seen a biphasic pattern with a rapid decline after the initial peak. Aijun Sun, in her PhD thesis, (3) showed acetate time–activity curves just like ours, with a rapid increase that reached a plateau after 3 min. Therefore, the biphasic morphology in the prostate curves of Mena et al. is a reason for concern. Given the biphasic shape of the prostate time–activity curves, it is not surprising that Patlak graphical analysis did not fit, since the Patlak plot performs best for uptake curves reaching a plateau.

The prostate time–activity curves of Mena et al. peaked at around 5 min, and they attributed this finding to initial tumor perfusion and dispersion. This cause is unlikely, since the iliac vessels are near the prostate gland and peak within 1 min (2,3). Their Figure 1 depicts an input function (iliac curve) with a maximum standardized uptake value just above 10, which is similar to ours, at 10.5, after removing the partial-volume correction. The peak of prostate cancer in Figure 1 is approximately 70% of that of the input function, indicating that the perfusion is high (estimated at >1.5). We found the 3-compartment, 3-parameter model optimal for the prostate (2) and measured an average perfusion of 0.42 for primary prostate cancer, 0.21 for recurrent cancer, and 0.34 for benign prostatic hyperplasia. These values compare favorably with Sun's 0.3 (estimated) for recurrent prostate cancer (3). Normal prostate perfusion measured with nuclear magnetic resonance techniques yielded 0.23 for Lüdemann et al. (4) and 0.26 for Li and Metzger (5). (All perfusion units are in mL/min/g, assuming a specific mass of 1 g/cm³ for prostate tissue.)

The relatively late appearance of the prostate peak in Figure 1 (~5 min), implies that acetate has a long residence time in prostate tissue, suggestive of a large distribution volume (estimated at >5 mL/g, compared with our 1.25 mL/g). What accounts for such a large apparent distribution volume?

To put this in a biologic perspective, the prostate cancer uptake curves of Figure 1 suggest a perfusion similar to that of the myocardium. Myocardial acetate kinetics measured in our laboratory showed a biphasic pattern with an early peak at 1–2 min, which can safely be interpreted as the tracer transit time through tissue. Thereafter, the myocardial time–activity curve demonstrated a continuous drop, without a plateau (6).

When the experiments of Mena et al. are compared with ours, there is a major difference in the acquisition protocol. Our acquisition consisted of a single dynamic scan of 21 min. Mena et al. used dynamic imaging for 6 min followed by 4 static scans.

This mixing of dynamic and static imaging raises concern on whether technical factors could be responsible for the biphasic uptake curve of the prostate. Did the authors perform a phantom experiment to validate the combined dynamic and static protocol?

In summary, Mena et al. reported a biphasic shape for acetate uptake in the prostate—a pattern strikingly different from what others have found. The data of Mena et al. suggest values for prostate perfusion and distribution volume that are too high. This possibility is concerning and raises questions about technical issues.

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REPLY: We thank Schiepers et al. for their comments on our article (1). Schiepers et al.'s publication on a similar topic (2) did not show the biphasic pattern of ^{11}C -acetate uptake that we saw in some patients. In response, we reviewed all the time–activity curves generated for our subjects both for tumor and for benign prostatic hyperplasia in the prostate, blood pool, and muscle volumes of interest. The summary data plots of the time–activity curves for ^{11}C -acetate uptake, as shown in Figure 1 of our article, are an average representation across all subjects. Within these data, we found 2 classes of uptake curves, as shown in the plots in Figures 1A and 1B of our article. One class clearly demonstrated a biphasic pattern (e.g., subject 36), whereas the other demonstrated a simple, irreversible uptake pattern (e.g., subject 28) more consistent with Schiepers et al. When averaged together, the biphasic pattern emerges.