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LETTER TO THE EDITOR

Performance of ^{18}F-FDG PET/MRI and ^{18}F-FDG PET/CT for T and N staging in patients with non-small-cell lung cancer

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Sir,

We read with great interest the recent article by Kirchner and colleagues who compared the performance of ^{18}F-FDG PET/CT and ^{18}F-FDG PET/MRI for primary (T) and locoregional lymph node (N) staging in patients with non-small-cell lung cancer (NSCLC) [1]. ^{18}F-FDG PET/CT and ^{18}F-FDG PET/MRI were successively performed at 60 min and 120 ± 16 min after tracer injection, respectively. T and N stages were determined according to the seventh edition of the American Joint Committee on Cancer staging manual [2]. Quantitative agreement between the two methods in terms of the maximum standardized uptake values (SUV_{max}) and the sizes of the primary tumours was assessed using Bland-Altman plots. The authors concluded that ^{18}F-FDG PET/MRI and ^{18}F-FDG PET/CT show equivalently high performance for T and N staging in patients with NSCLC. However, they recommended that the quantitative assessment of treatment response should be performed on the same equipment (either PET/MRI or PET/CT) to provide reliable intraindividual measurements. In particular, they acknowledged that, since ^{18}F-FDG PET/MRI was performed after ^{18}F-FDG PET/CT, the time-dependent increase in radiotracer accumulation in tissues may play a role for variations in SUV_{max} between the two methods.

As ^{18}F-FDG PET/MRI may be an alternative to ^{18}F-FDG PET/CT for the NSCLC thoracic staging in current clinical practice, we would like to point out that the authors' experiment sequence, i.e., ^{18}F-FDG PET/MRI performed after ^{18}F-FDG PET/CT, may have had an impact on their conclusion because of the correction for the tracer decay that is usually applied to the SUV_{max} by the manufacturer. Instead of the time-dependent increase in radiotracer accumulation in tissues, we suggest that the decay correction factor has boosted ^{18}F-FDG-PET/MRI SUV_{max} in comparison with ^{18}F-FDG-PET/CT SUV_{max}. As a consequence, determining NSCLC thoracic staging from PET/MRI-image analysis has very likely been biased, since a visually increased uptake in a tissue of interest involves its SUV_{max}.

The effect of applying the decay correction factor is illustrated in Fig. 1 that shows the time dependence of the SUV (on average), which was obtained from recently published data in a lung cancer patient series [3]. The *decay-uncorrected* SUV is proportional to the radioactivity concentration that is actually measured in a tissue of interest. The *decay-corrected* SUV is the *decay-uncorrected* SUV multiplied by $\exp(\lambda \times t)$, where λ is the ^{18}F physical decay constant and t is the time between injection and acquisition. The *decay-uncorrected* SUVs at 60 min and 120 min after injection, i.e. the (average) times between injection and acquisition of PET/CT and PET/MRI in the authors' experimental design, respectively, are on each side of a smooth peak (at 84 min after injection, on average), and hence are very close. This feature rules out that the time-dependent increase in radiotracer accumulation in tissues may play a significant role for variations in SUV_{max} between the two methods.

The ratio between *decay-corrected* SUV at 120 min and at 60 min is 1.43. In other words, concluding that ^{18}F-FDG PET/MRI SUV_{max} (at 120 min after injection) and ^{18}F-FDG PET/CT SUV_{max} (at 60 min after injection) are not significantly different (involving decay correction) means that ^{18}F-FDG PET/MRI underestimates the radioactivity concentration in a tissue of interest by a factor of about 1.43 in comparison with ^{18}F-FDG PET/CT. It is noteworthy that, if the experimental sequence is reversed, that is PET/CT and PET/MRI are performed at 120 min and 60 min, respectively, the discrepancy between the two imaging techniques in reporting the *decay-*

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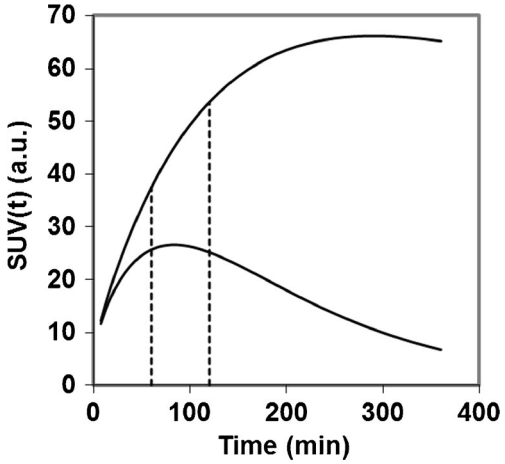

Fig. 1 SUV (in arbitrary units) versus time without (*lower curve*) and with (*upper curve*) correction for ^{18}F physical decay. The vertical dashed lines are drawn at 60 min and 120 min after injection

corrected SUV_{max} in a tissue of interest may reach a factor of about 2 (= 1.43^2, resulting from multiplication of the underestimation factor for ^{18}F-FDG PET/MRI by the boosting decay-correction factor for ^{18}F-FDG PET/CT). With this reversed experimental design, ^{18}F-FDG PET/CT would thus appear superior to ^{18}F-FDG PET/MRI for the thoracic staging of NSCLC.

To conclude, we are convinced that ^{18}F-FDG PET/MRI is of great value for thoracic staging of NSCLC as an alternative to ^{18}F-FDG PET/CT, and breakthroughs in lung MRI will certainly further increase its potential [4]. Nevertheless, the equivalence between the two imaging techniques reported by Kirchner et al. in their study may be a result of the experimental design, i.e. on the fixed sequence of PET/CT followed by PET/MRI that were performed at 60 min and 120 min, respectively, leading to boosting of the PET/MRI SUV by application of the decay-correction factor.

Compliance with ethical standards

Conflicts of interest None.

Research involving human participants and/or animals Not applicable.

Informed consent Not applicable.

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