Optimal dose of injection in activation study with O-15 water and PET

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In activation studies with the bolus method for O-15 water and PET, the radiotracer concentration may reach the limits of the system in terms of dead time correction and accidental coincidence. To obtain the optimal injection dose of O-15 water, we performed a normal volunteer study to evaluate the relationship between the injected dose and the radioactivity concentration in the brain and a phantom study to evaluate the performance of the PET scanner (PCT:3600W) under high count rate conditions and the effect of averaging on the signal to noise ratio for the PET images.

A linear relationship was noted between the injected dose (normalized for each body weight: x) and the mean radiotracer concentration in the brain measured by PET (y) (y = 2.52 + 0.30x, n = 64, r = 0.87, p < 0.001). The percent error in the measurement of radioactivity with PET was within ±5% in the 100 to 2000 nCi/ml (3.7-74 KBq/ml) range. Below 100 nCi/ml (3.7 KBq/ml), the percent error increased due to the rapid increase in noise in the reconstructed images. Over 1000 nCi/ml (37 KBq/ml), on the other hand, the noise was almost unchanged.

With our PET scanner, the optimal range of the radiotracer concentration in the brain is below 1000 nCi/ml (37 KBq/ml), corresponding to an injection dose of 33 mCi (1.22 GBq)/60 kg body weight. With the same total dose, the increment of number of repeated measurements for averaging provided the better signal to noise ratio. In designing a paradigm for an activation PET study, the injection dose and the number of repeated measurements for averaging should be considered.

Key words: PET activation study, O-15 water, optimum dose, signal to noise ratio