Comparative measurement of spill over ratio between I-124 and F-18 on Siemens ECAT HR+ PET scanner

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1. Introduction

Although fluorine-18 (Half life: 109 min) was widely used for PET imaging, there was limitation due to short half life[1]. I-124 has long life (4.02 day) that was possible for verification of phasing images (wash-in and wash-out). However, quality of I-124 PET image was not comparable to those of F-18 PET image since it has multiple decay scheme (602, 722, 1691 KeV) with high gamma energy and low branching ration of positron (23%). In this study, Comparative measurement of spill over ratio between I-124 and F-18 was performed in Siemsens ECAT HR+ PET scanner.

2. Methods and Results

PET data was acquired using 2D whole-body and 3D brain modes, respectively. PET data was reconstructed using both filtered back projection (FBP) and ordered-subset expectation maximization (OSEM) method. Energy window was within 350 ~ 650 keV.

2.1 System description

The detector ring was Bismuth germanate (BGO) material, each crystal dimensions were 4.4 x 4.39 x 30 mm, crystal per detector blocks were 64, and number of detector blocks were 288. Axial field of view (FOV) was 155 mm, total number of crystals were 18,432. The coincidence time window was set 12 ns, dead time was 5000 ns, and energy resolution was 26% [2].

2.2 Spill over ratio measurement

Measurement of spill over ratio was performed using Utah phantom. The schematic of utah phantom was described in Figure 1.

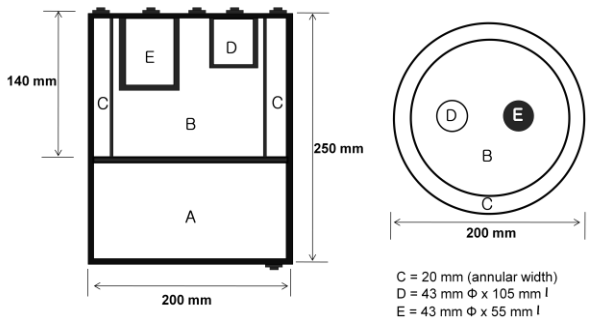

Fig. 1. Specification of Utah phantom.

The activity concentration in Utah phantom compartment 1 was 5.3 kBq/cc and compartment 2 was 21.2 kBq/cc, compartment 3 was filled water, and compartment 4 was filled air. Following figures were representative PET images using Utah phantom.

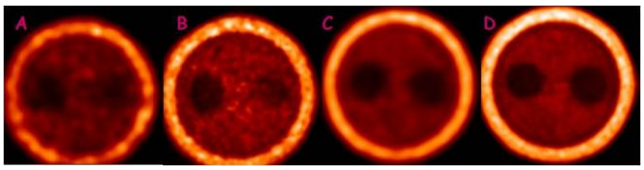

Fig2. Representative Utah phantom Images (A: I-124 2D whole-body mode, B: I-124 3D brain mode, C: F-18 2D whole-body mode, D: F-18 brain mode).

For the analysis of spill over ratio (SOR), ROIs was drawn on 75% of active diameter (compartment 2), and drawn on 50% of cold diameter (compartment 3, 4). The same size ROIs was drawn on the ±2 slices on the center slice [3].

SOR was calculated using following equation.

$$SOR(\%) = \frac{Cold\ resion}{Hot\ uniform\ resion} \times 100$$

Table 1 was the result of SOR in I-124 and F-18 PET data

Table 1: Result of Spill over ratio

Cold Lesion	I-124 (%)		F-18 (%)	
	Whole body	Brain	Whole body	Brain
Air	62.11	51.62	60.53	48.46
Water	34.15	40.18	24.01	27.18

3. Conclusions

SOR of I-124 was higher than those of F-18. This would be due to the effect of higher energy single gamma. For the quantification of I-124, prompt coincidence from the higher energy (602, 722 keV) should be considered.

REFERENCES

[1] W. Jentzen, R. Weise, J. Kupferschläger, L. Freudenberg, W. Brandau, R. Bares, W. Burchert and A.

Bockisch, *Iodine*-124 PET dosimetry in differentiated thyroid cancer: recovery coefficient in 2D and 3D modes for PET(/CT) systems, Eur J Nucl Med Mol Imaging, Vol. **35**(3), p. 611-23, 2008.
[2] N. Karakatsanisa, N. Sakelliosa, N.X. Tsantilasb, N. Dikaiosa, C. Tsoumpasd, D. Lazaroe, G. Loudosa, C.R. Schmidtleinf, K. Louizib, J. Valaisc, D. Nikolopoulosb, J. Malamitsib, J. Kandarakisc and K. Nikitaa, Comparative evaluation of two commercial PET scanners, ECAT EXACT HR+ and Biograph 2, using GATE, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Vol.569(2), p. 368-372, 2006
[3] National Electrical Manufacturers Association (NEMA), Performance Measurements of Small Animal Positron Emission Tomographs. NEMA Standards Publication NU4-2008. Rosslyn, VA: National Electrical Manufacturers Association; 2008.