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Phantom Preparation and Acquisition

PLOS One

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1 Works for me [dx.doi.org/10.17504/protocols.io.bqtsmwne](https://doi.org/10.17504/protocols.io.bqtsmwne)



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ABSTRACT

The PET data were acquired using a 3T hybrid MR-BrainPET insert system (SIEMENS, Erlangen, Germany) in list mode. The coincidences were corrected for random events using the delayed window technique with VRR, dead time, attenuation and scattered coincidences (single scatter simulation – SSS method), and physical decay. An adapted NEMA phantom, without lung insert and with six sphere inserts, was used. One insert was filled with ¹¹C and the others contained cold (no activity) water contrasting in a warm background cylinder. Coincidence data were acquired during eight isotope half-lives, giving 163 minutes total acquisition time for ¹¹C, which has a half-life of $T_{1/2} = 20.35$ minutes. The ratio of the activity concentration between the sphere (Hot with 28 mm of nominal internal diameter) and the background region (BG) was 1.85:1. This value is frequently found for the ratio of activity concentrations in the grey matter cortex (GM) and cerebellar grey matter (reference region) during the steady-state condition in [¹¹C]ABP688 studies. A cold transmission scan of the adapted NEMA phantom using ⁶⁸Ge sources was acquired in a Siemens ECAT Exact HR+ PET scanner. This acquisition (2 bed positions, 20 minutes of transmission, reconstructed with OSEM 2D – 6 iterations and 16 subsets and a 256 × 256 matrix) was used to create the attenuation map for the phantom used in the ¹¹C decay study.

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Adapted NEMA Phantom Preparation: 36m

36m

1

Adapted NEMA Phantom Preparation with ^{11}C ⌚ 00:30:00 :

Activity at the acquisition start time [t=0] in the PET scanner:

📄 122.43 kBq/ml - Larger Sphere Activity (Hot)

📄 66.03 kBq/ml - Background Activity (BG)

The values were confirmed by average of 3 probes measured (⌚ 00:06:00 1 min each probe) in a gamma counter (WIZARD automatic gamma counter – PerkinElmer®)

📄 0.5 mL with diluted ^{11}C - 3 probes from Hot and BG compartments

desired activity ratio = 2

achived = 1.85

Positioning and Acquisition: 2h 43m

2h 43m

2

The phantom was positioned in the same conditions to represent an [^{11}C]ABP688 acquisition protocol of the human brain study in the PET scanner FOV. Schematic positioning can be observed below comparing human head and phantom:

📄 Experiment_Human_Phantom.bmp

Phantom acquisition was performed during ⌚ 02:43:00 approximately 8T_{1/2} of ^{11}C (table below), but a range of 3T_{1/2} to represent the human clinical study were selected.

Activity concentration per half-life [T_{1/2}] during the acquisition moments are presented below:

A	B	C
	HOT Insert	BG
Number[T1/2]	Average Act. kBq/ml	Average Act. kBq/ml
2T1/2	60.79	32.79
3T1/2	30.19	16.28
4T1/2	14.99	8.08
5T1/2	7.44	4.01
6T1/2	3.70	1.99
7T1/2	1.84	0.99
8T1/2	0.91	0.49

Table with corresponding Hot and BG activity concentrations per half-life $T_{1/2}$ during the decay experiment

Acquisition Range Selection for Analysis:

- 3 We selected the 4th, 5th and 6th half-lives range to represent the [¹¹C]ABP688 which has a similar True counts per second range in the referred interval. Please check the True counts per second range over time curve below (from the phantom acquisition).

 [Trues_Fig24.bmp](#)

Attenuation Map:

- 4 A cold transmission scan of the adapted NEMA phantom using ⁶⁸Ge sources was acquired in a Siemens ECAT Exact HR+ PET scanner. This acquisition (2 bed positions, 20 minutes of transmission, reconstructed with OSEM 2D – 6 iterations and 16 subsets and a 256 × 256 matrix) was used to create the attenuation map for the phantom used in the ¹¹C decay study.

 [Att_map.png](#)

Reconstruction and Analysis:

- 5 Details can be found better described in:

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