Construction of different radionuclide templates of rat brains and their use on a new statistic parametric mapping analysis protocol for PET studies

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Quantification of PET studies requires the identification of anatomical structures for the evaluation of physiological parameters in the relevant brain areas. This delimitation of volumes of interest (VOIs) is the most critical step of the process and introduces great variability. SPM (statistic parametric mapping) permits automatic analysis of different groups of specimens avoiding operator variability implicit in the definition of VOIs.

Aim: To develop protocols to create new ^{18}F-FDG and ^{11}C-DTBZ (dyhidrotetrabenazine, a VMAT2 transporter ligand) templates of rat brain for spatial normalisation and definition of standardised areas in images used for setting up SPM analysis of PET data.

Materials and methods: Eleven *Sprague-Dawley* rats initially underwent a brain MRI (magnetic resonance imaging) operating at 4'7 Teslas in the Complutense University of Madrid (UCM). Three days later, rats were transported to the MicroPET Research Unit from the University of Navarra. In order to have two groups well differentiated, ^{18}FDG PET studies were conducted in two conditions: awaken and under isoflurane anaesthesia during the uptake period of ^{18}FDG. Additionally ^{11}C-DTBZ PET studies were done to six of the animals.

MRI studies were normalised to a widely known template [**1**] and the transformation matrix was saved for further use. PET studies were co-registered to their corresponding MRI and normalised using the above-mentioned matrix. Normalised PET images were averaged and smoothed to obtain a first template. Using it as reference, the process was repeated twice to define the final template. Finally, we obtained ^{18}FDG templates of awaken and anaesthetised rats. The same protocol was used to create the ^{11}C-DTBZ template (**Figure 1**).

FDG uptake differences between awaken and anaesthetised rats were assessed using SPM two-sample paired t-test. To validate results from the PET SPM analysis we compared them with a 3D autoradiography SPM analysis we have previously reported [**2**].

Results: Both ^{18}F-FDG and ^{11}C-DTBZ templates permitted an excellent spatial fit between images. SPM analysis showed the significant cerebral activation of specific regions on awaken rats as compared to anaesthetised rats (**Figure 2**). The developed protocol is a robust way to avoid operator variability. The overall process is validated by comparison between PET and 3D autoradiography results.

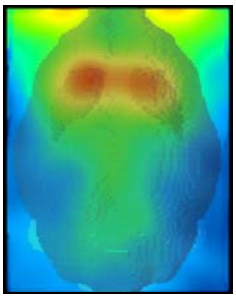

Figure 1: ^{11}C-DTBZ PET Template

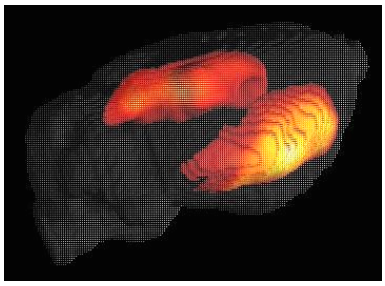

Figure 2: 3D image of ^{18}FDG PET SPM analysis

Conclusions: The construction of different ^{18}F-FDG and ^{11}C-DTBZ templates and their use for spatial normalisation allowed the standardisation of the PET quantification procedure by SPM analysis, resulting in an operator-independent method. For further validation, SPM results were compared with a 3D autoradiograthy SPM analysis.

References:

1.- P.Schweinhardt et al. J. Neuroscience Methods (2003) 129:105-113

2.- M.Collantes et al. Rev. Esp. Med. Nucl. (2010) 29:29