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Assessment of easyPET for ^{18}F-FDG neurological studies in mice

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Abstract

Preclinical Positron Emission Tomography (PET) systems can be applied for small animal imaging to study human diseases, to validate new drugs and therapeutics, as well as to develop new PET radiopharmaceuticals for diagnosis. However, the access to preclinical PET scanners is not easy due to its high complexity and cost. EasyPET, a new concept of PET scanner with a simple and unique image acquisition method based on two rotation shafts for the movement of detector pairs, represents a solution to this problem, while keeping a fair sensitivity and achieving state-of-the-art spatial resolution. Small-animal imaging has mainly been applied in the field of neurology for preclinical evaluation of potential therapies. In this work, the first results obtained with a small-scaled version of easyPET (training version) for mice brain imaging with ^{18}F-FDG are presented. The subject received different stimuli, which activated in a specific way the brain structures. An acquisition without any stimulus was used as control. The results suggest that easyPET is suitable for preclinical imaging research, since it produces high quality mice images, by clearly identifying the main brain regions.

The easyPET concept

see poster M-07-116

The easyPET, a patented microPET system, has an innovative acquisition method based on two rotation shafts for the movement of detector pairs, which are kept collinear during the acquisition, thus allowing to eliminate parallax errors (no Depth of Interaction effect in the transverse plane).

easyPET performance: first preclinical results

A ^{18}F-FDG study was performed on a healthy Balb/c mouse (female, 8-10-weeks-old, 24 g) to demonstrate the easyPET potentiality for preclinical studies. The protocol applied is represented in the scheme bellow. A heating system was used to keep the animal warm. The subject received different stimuli: light and sound, cocaine and quercetin, which activated specific brain structures. An acquisition without any stimulus was used as control. Animal studies were performed according to the national and international legislation (Dec-Lei 113/2013, ORBEA 17/2017). EasyPET images were reconstructed with the 3D MLEM-OSEM algorithm (list mode, one iteration and 20 subsets).

Methods

^{18}F-FDG
Activity = 535 µCi
Intraperitoneal (i.p.) injection

20 min

L+S Stimulus
1st Flashing Light: 10 sec
2nd Sound: 80 db: 10 sec

5 min

L+S Stimulus
1st Flashing Light: 10 sec
2nd Sound: 80 db: 10 sec

5 min

Anesthesia
Ketamine (50mg/mL) + Largactil (2.5mg7mL) 1:3, diluted in saline 1:1
i.p. injection

20 min

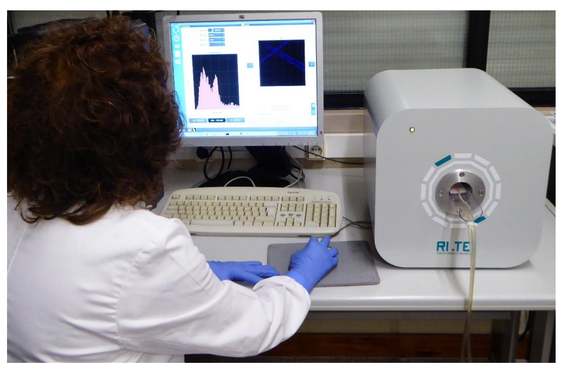
L+S Acquisition
Medium Continuous
50 minutes
Prone positioning

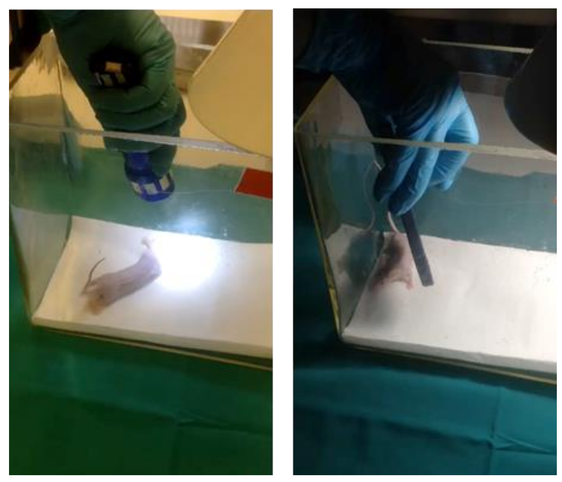
Cocaine Stimulus
0.013 mg/0.1 mL
i.p. injection

Cocaine Acquisition
Medium Continuous
50 minutes
Prone positioning

Quercetin Stimulus
1 mg/0.500 mL (0.15 mL methanol + 0.35 mL PBS)
i.p. injection

Quercetin Acquisition
Medium Continuous
50 minutes
Prone positioning



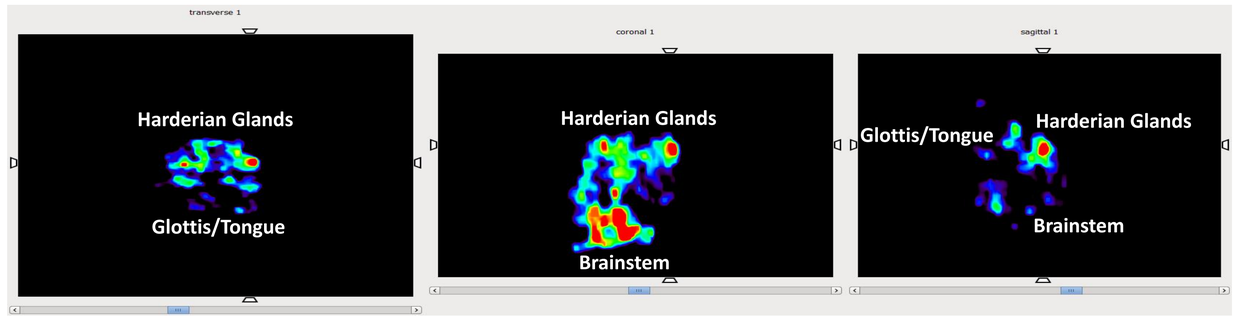


Results and Case Study Examples

Control Study (No Stimulus)

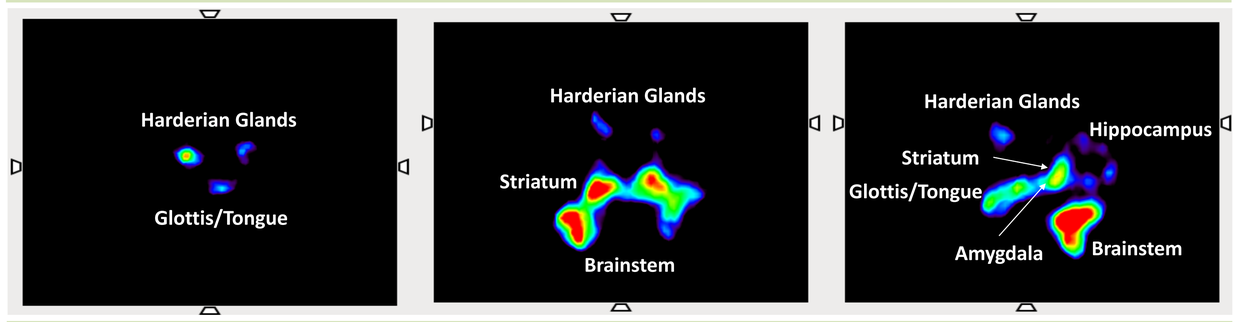
Transverse, coronal and sagittal views show the main structures activated in the mouse brain by FDG: olfactory bulb, basal forebrain and septum, striatum, thalamus, hippocampus, amygdala, hypothalamus, cerebellum and brainstem.

Light and Sound Stimulus

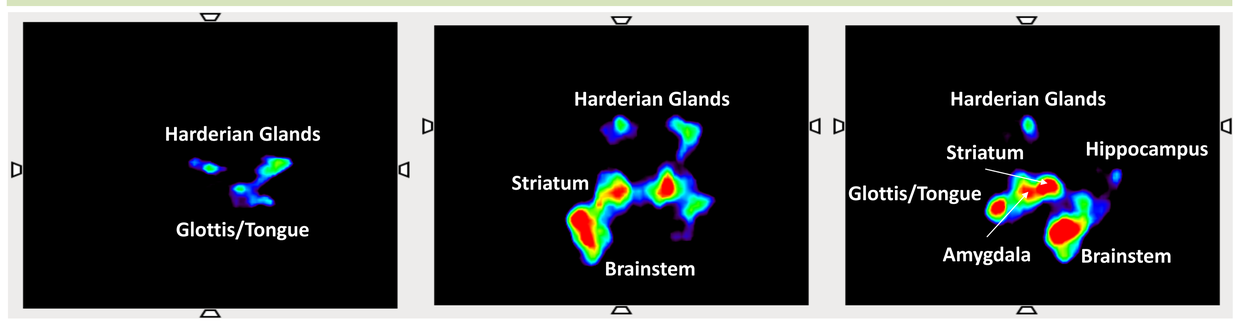


Transverse, coronal and sagittal views illustrate the brain regions related with visual and auditory sense that were activated by the light and sound stimulus.

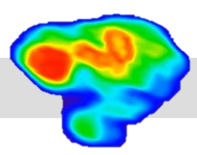
Cocaine Stimulus



Quercetin Stimulus



Transverse, coronal and sagittal views present the mouse brain areas responsible for craving, that were activated by cocaine stimulus: striatum and amygdala. The same structures can be seen in the quercetin stimulus acquisition, demonstrating the potentiality of this natural substance for the treatment of cocaine-dependent patients.



Conclusions

- Suitable for preclinical imaging research
- Versatile small-animal device (applied in a variety of studies, including the neurology field)
- Fair sensitivity
- Excellent spatial resolution (~1 mm, FBP)
- High quality mice images
- Based on recent developments, further performance improvements can be expected and will be presented

References

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