A new fillable mouse phantom for the assessment of demanding imaging protocols in preclinical PET/SPECT

M. Rouchota[1], Ch. Sfyris[1], E. Fysikopoulos[1], M. Georgiou[1], G. Loudos[1]

[1]Bioemission Technology Solutions (BIOEMTECH), Research & Development, Athens, Greece

Aim of the project: A new generation of fillable mouse phantoms has been designed and evaluated, with the aim of allowing easy and reproducible evaluation of preclinical nuclear imaging systems and assessment of demanding protocols.

Methods & Materials:

The phantoms are manufactured from a soft-tissue-mimicking material, compatible with Nuclear Imaging, Computed Tomography, Magnetic resonance imaging and optical imaging systems and it contains major organs (brain, thyroid, heart, liver, kidneys, bladder) and two tumours. The anatomy of the mouse is based on Digimouse, a mouse model extracted from anatomical and cryosection data. (Dogdas et al., 2007).

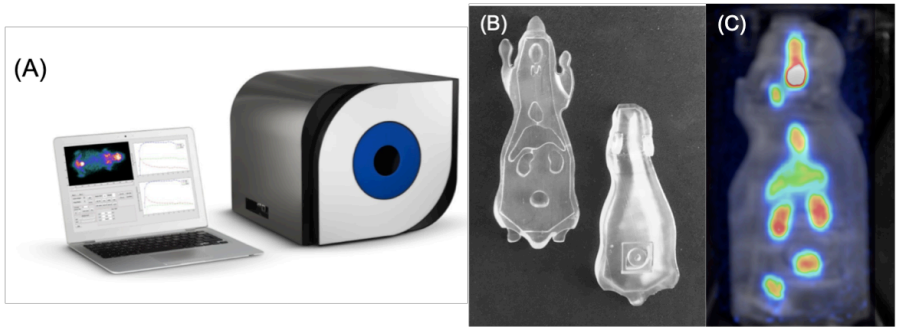

Figure: (A) The β-eye™ (BIOEMTECH) screening system, for real-time, dynamic, whole-body mouse imaging of PET isotopes; (B) Photo of the fillable mouse phantom; (C) Nuclear Image of the fillable mouse phantom using 23 uCi of ^{18}F-FDG on β-eye™ (BIOEMTECH); Activity is distributed in brain, thyroid, heart, liver, kidneys, bladder and the two small "tumors".

The first evaluation of the mouse phantom with PET isotopes has been performed on β-eye™ (BIOEMTECH, Greece), a benchtop screening system for real-time, dynamic, whole body mouse imaging of PET isotopes. Low activities (20-30 uCi) of ^{18}F-FDG have been used and the activity of the applicable volume on each organ has been measured on a dose calibrator (DC).

The imaging results have been quantified as %ID/organ and compared with those of dose calibrator (%ID/organ).

Results: The comparison between organ values measured though the imaging system and through the DC, given as %ID/organ, are given in the following table:

Organs	%ID/Organ from DC	%ID/Organ from image	Deviation (%)	Deviation / mm3 (%)
Lower Tumour	7,1	6,7	6,1	0,030
Bladder	10,5	9,8	6,7	0,023
L.Kidney	12,7	12,3	2,9	0,008
R.Kidney	12,7	12,5	1,5	0,004
Liver	23,8	19,7	17,3	0,015
Heart	9,9	8,3	16,0	0,058
Upper Tumour	4,8	4,6	4,5	0,030
Thyroid	12,0	13,8	15,1	0,328
Brain	6,6	6,9	4,4	0,025

It is noted that deviations of measured dose are on average (8 ± 5)%, whereas when converted to deviation per mm3 it is lower than 0.5%, yielding a succesful test and showing a sound methodology to evaluate imaging data processing accuracy on a PET system.

Discussion & Conclusions: Imaging results have shown accurate biodistribution values, a very good discrimination of internal organs and highlighted the ability to accurately simulate complicated experimental setups, without the need of actual rodents. It has also illuminated the ability to extensively study specific biodistributions, without the arbitrariness related to a living animal. The use of these phantoms can lead to the reduction of costs, related to animal use and preparation and to an excellent compliance with bioethics and the 3Rs principle.