



Current Brazilian Scenario about Quality Assurance in preclinical PET imaging systems

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1. Introduction

Preclinical positron emission tomography (PET) is an important molecular imaging modality of small animals such as rats and mice using. Preclinical PET can generate static and/or dynamic images applied to biochemical, metabolic, and functional study of organs and tissues. [1] In the context of nuclear medicine, these systems are widely used for the development of new radiopharmaceuticals or in studies of new applications of traditional radiopharmaceuticals. [2]

The NEMA NU 4/2008 publication presents all the methodological parameters and needs for the small-animals PET quality control. According to the publication, PET performance should be evaluated by the following parameters [3]:

- i) Spatial Resolution;
- ii) Sensitivity;
- iii) Coincidence Events Rate; and
- iv) Image Quality.

In addition to the PET system another important equipment - activity meter - it is used daily in the laboratorial routine and requires continuous evaluation of its performance. [4,5]

In Brazil, there are few preclinical PET in use and to know where they are installed and how they working is important to harmonize their use in the research field, [6] specially about their quality performance. Every imaging technology needs to be evaluated by a set of quality tests for that confirms their performance or indicates the need for corrective maintenance. [7]

Thus, the aim of this work was to evaluate the current Brazilian scenario about quality assurance program of preclinical PET imaging systems.

2. Methodology

An electronic survey (In Portuguese) was prepared and applied. Its main goal was to know the current scenario about preclinical PET scanners performances available at the Brazilian research centers. The electronic survey with contained specific topics on preclinical PET systems and their quality assurance programs. Table 1 presents the topics covered in research.

Table I: Topics covered in electronic research.

Topics covered			
i)	Preclinical PET systems	Quantity and Type (manufacturer and model)	
ii)	Quality Assurance Program	PET systems	Dose Calibrator (activimeters)
	Quality Control tests	NEMA NU 4/2008 publication [5]	National regulation (CNEN NN 3.05, 2013)
	Materials and Methods	Specific phantoms and Sources required	Sources required

In addition to the topics in Table I, it was asked whether there is an interest in the implementation of quality assurance program (if it is not available at the answer moment – first semester of 2021).

The electronic research was sent by e-mail to all Brazilian molecular imaging preclinical centers that participated on the first microPET/SPECT/CT Users meeting held at the Federal University of Rio de Janeiro in 2015. It is important to say that this study is an update of the survey previously conducted by Gontijo *et al* (2020) due to the change in the current scenario. The answers were compiled in Excel software and descriptive statistics were done for further analyses.

3. Results and Discussion

Table 2 presents the results for the first topic covered in the electronic survey.

Table 2: Preclinical PET systems (Quantity and Type) used in Brazilian research centers.

Centers	Geographic Region	State	Institution	Equipment
1	Southeast	SP	IPEN/CNEN ^(a)	Albira Trimodality microSPECT/PET/CT (Brucker)
2			HCFMUSP ^(b)	Triumph [®] LabPET 8 Trimodality PET/SPECT/CT (Gamma Medical Ideas/GE Healthcare)
3			UNICAMP ^(c)	Beta Cube (Molecubes)
4		RJ	UFRJ ^(d)	Albira Trimodality microSPECT/PET/CT (Brucker)
5		MG	CDTN/CNEN ^(e)	Triumph [®] LabPET 8 Trimodality PET/SPECT/CT (Gamma Medical Ideas/GE Healthcare)
6	South	RS	PUC-RS ^(f)	Triumph [®] LabPET SOLO 4 (Gamma Medical/GE HealthCare)
				Triumph [®] LabPET 4 Bimodality PET/CT (Gamma Medical Ideas/GE Healthcare)

Note: (a) IPEN/CNEN: Instituto de Pesquisas Energéticas e Nucleares; (b) HCFMUSP: Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo; (c) UNICAMP: Universidade de Campinas; (d) UFRJ: Universidade Federal do Rio de Janeiro; (e) CDTN/CNEN: Centro de Desenvolvimento da Tecnologia Nuclear; (f) PUCRS: Pontifícia Universidade Católica do Rio Grande do Sul.

There are six preclinical molecular imaging centers using seven PET systems for small animals. Among them, five are in the Southeastern region and one in the South region. Anyone in North or Northeast neither in Midwest region.

Triumph II platform with LabPET software is predominant (used in 4 services); the Albira manufacturer are used in 2 different centers and Molecubes is used in a center that have 2 systems available.

In table 3 it can be seen a part of the internal procedures of quality assurance that are adopted in each center. Centers were not identified to preserve the internal routines.

Table 3: Quality Assurance Program (Tests and Materials) adopted in centers.

Centers [§]	Phantoms (NEMA) and Sources	Quality Assurance Program (QAP)		
		Implemented		Interest in QAP
		PET system	Activimeter	
i	No	No	Yes	Yes
ii	No	No	Yes	Yes
iii	Yes	Yes	Yes	Yes
iv	*	*	Yes	Yes
v	No	No	Yes	Yes
vi	No	No	Yes	Yes

Note: (§) Centers not identified for confidentiality. * Information not provided

In addition to the answers presented in the table above, all services stated that are familiar with NEMA NU 4-2008 and its performance evaluation methods specific to small animal PET scanner.

4. Conclusions

There are seven preclinical PET devices installed in Brazil and most are concentrating in southeast region. Only one center has 2 PET systems available. Only one research center has the totally quality assurance program implemented for PET scanner including the specific phantoms and the point source as recommended by NEMA NU 4/2008 publication.

There is no quality assurance program for PET scanner implemented in most of the centers but is unanimous their importance in preclinical molecular imaging research field.

Summarizing, small animal PET has an important role in bridging the gap between basic, preclinical, and clinical research and clinical application. Thus, the present study is an update of the scenario regarding the adoption (or not) of a quality assurance program in preclinical PET systems in Brazil and to corroborate a proposal for national standardization.

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