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Mini Review

Computational system for activity calculation of radiopharmaceuticals

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The preparation of radiopharmaceuticals for distribution to several hospitals is practised widely and the transport is usually by road and plain, this is specially practised in big countries like Brazil where the distance from one state to other is bigger than one country compared to others in continents like Europe. The purpose of this paper is to describe a computational system developed to evaluate the dose of radiopharmaceuticals during the production until the final receptor (hospital).

Key words: Radiopharmacy, radiopharmaceuticals, computer system, doses, activity calculation.

INTRODUCTION

Since the introduction of radionuclides, latter called radiopharmaceuticals, in the medicine practice, a great number of diseases have been treated using this kind of drug. The most common applications of radiopharmaceuticals are in the nuclear medicine and oncology, but now cardiology and neurology are using radiopharmaceuticals too (Hamble and Lowe, 2003; Academy of Medicine, 2004; Nakamoto et al., 2003; Verboom et al., 2003; Heinrich et al., 2005). There are a great number of radiopharmaceuticals in use around the world with several applications: 18F-FDG, 15O-water, 15O-C-monoxide, 13N-ammonia, 11C-methionine, 18F-DOPA, Ga-67, 99m-technetium, I-131 among others (Meyer et al., 1995; Early, 1995; Ekberg et al., 2007).

One of the main problems of radiopharmaceuticals is its independence of mass. In this type of drugs the power is express in energy and not in a mass-dependent concentration (Finn, 1999). Such fact leads to another type of problem, that has consequences right-handers in its legislative regulamentation, that is, its production of batchs. In accordance with Finn (1999), one batch of radiopharmaceuticals can be a simple dose, or less.

Radiopharmaceuticals serve two complementary roles. The first is a pragmatic one in which the labeled compound is administered to the patient and some aberrant physiological or biochemical process leads to an abnormal distribution of the compound. In the second role the radiopharmaceutical is a tracer for particular physiological or biochemical process and the time course of its distribution is used to quantitate the biological process (Tewson and Kronh, 1998; Baranowska-Kortylewicz, 2007). The preparation of radiophramaceuticals in industries or central radiopharmacies for distribution to several hospitals or clinics is practised widely around the world and the preocupation with transport and activity (dose) was already stated by Johnson and Millar (1997).

Considerations such as diagnostic accuracy, ease of use, image quality, and patient comfort and convenience should generally dictate the choice of a radiopharmaceutical, with radiation dose being only a secondary or even tertiary consideration. Counseling of nuclear medicine patients who may be concerned about exposure should include a reasonable estimate of the median dose for the type of examination and administered activity of the radiopharmaceutical; in addition, it should be explained that the theoretic risks of the procedure are orders of magnitude lower than the actual benefits of the examination. Providing numeric estimates of risks from studies to individual patients is inappropriate, given the uncertainties in the dose estimates and the limited predictive power of current dose-risk models in the low-dose (diagnostic) range (Stabin, 2008). Considering the statement made by Stabin we do consider that the dose (activity) of the radiopharmaceuticals should be as precise as it can, to avoid any risk (unecessary) to patients.

DESIGN AND OPERATION

The computational software (Pat no. 020080085299) for radiopharmaceutcals's dose calculation was created using

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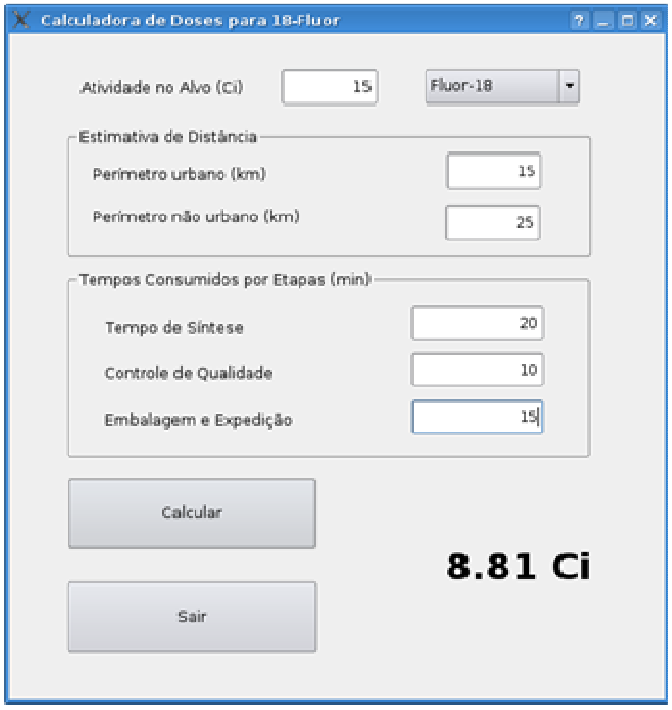

Figure 1. Radiopharmaceuticals activity calculator.

freeware tools and a Linux Operational System. This choice was made due a great number of stable and reliable development software for graphical interface applications in Linux environment, perhaps, the portability for Windows Operational System was guaranteed by the use of GNU GCC 4.1 compilator and a Troltech Qt 3.3 Graphical Library, this one a freeware in Linux environment with a very important aspects: no profits ends.

The tool developed is a tiny program, a calculator, (please note that all the fields are in portuguese, however it could be translate at any time) that have the follow fields.

1-“Atividade no Alvo (Ci)” – this field is relative to the activity in target, for example, the activity achieved after the synthesis process;
2-“Perímetro urbano (Km)” and “Perímetro não-urbano (Km)” – this field correspond the quality and type of traffic to arrive in the hospital. Choosing one of the alternative the other is descharged. It is related to differents averages velocities in relations to the traffic;
3- “Tempo de síntese”, “Controle de Qualidade” and “Embalagen e Expedição”- this field are related to the estimates times spent in the respectively process of synthesis, quality control and packaging and shipment.

After full entry of all these fields, the “Calcular” bottom provides the estimated activity in the hospital. The “Sair” Button exits the software.

In order to make the results obtained by the software more reliable a well know C/C++ ANSI compiler was used. GNU GCC is used around the world with excelent results specially in complex computational calculus as nuclear computational simulation. The software interface is showed in Figure 1.

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