2017 International Nuclear Atlantic Conference - INAC 2017
Belo Horizonte, MG, Brazil, October 22-27, 2017
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR – ABEN

Agência Brasileira do ISBN
ISBN 978-85-99141-07-6
9 788599 141076

A STUDY USING VIRTUAL REALITY AS A SOURCE OF COMPLEMENTARY INFORMATION FOR NUCLEAR MEDICINE PATIENTS AND ITS RELATIVES

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ABSTRACT

This work consists in the research, analysis and unification of the guidelines transmitted to the patients and their relatives in the radioiodine therapy procedures. The goal is to provide greater understanding of the use of nuclear radiation and better understanding of treatment, to help patients better adapt to therapy, to demystify misconceptions about radiation use, and to improve care for their protection and for people close to them. Based on written and verbal information, collected in the scientific literature and *in loco* accompanying the routine of the therapeutic rooms of Nuclear Medicine Services in Rio de Janeiro, the set of actions that define scenarios experienced by radioiodine therapy patients and their helpers is being generated. Based on this information, a virtual environment is being developed in the Virtual Reality Laboratory of the Institute of Nuclear Engineering (IEN / CNEN), a virtual environment that will allow the visualization of the procedures and instructions passed to the patients by the SMN1 teams. With this virtual environment, the patient will be able to perform an immersive visualization and to experience the different phases of the treatment, increasing the chances of efficiency of their participation in the process.

Keywords: nuclear medicine 1, virtual reality 2 medical exposure 3.

1. INTRODUCTION

The radioiodine or iodine therapy used in the treatment of thyroid gland carcinoma aims to eliminate remaining thyroid tissue after surgery, thyroidectomy, and eliminate any metastases. With references in international recommendations, such as the publications of the International Atomic Energy Agency (IAEA) and standards established by the National Nuclear Energy Commission (CNEN), this work deals with safety and radiation protection aspects with the objective of promoting the optimization of radiological exposure, whether The patient, family members and caregivers, as well as the general public, in the treatment of thyroid cancer with iodine-131.

[1]SMN Nuclear Medicine Service

Thus, a compilation and analysis of information about the routine of patients when hospitalized in the therapeutic room and the guidelines that are to be followed after their release is being prepared. This information will define scenarios in the virtual environment, under development in the Laboratory of Virtual Reality of the Institute of Nuclear Engineering (IEN), which will allow patients to know, in advance, the procedures and care of the treatment to be performed by themselves.

2. NUCLEAR MEDICINE AND RADIOIODOTHERAPY

Nuclear Medicine is a Medicine modality that uses ionizing radiation for the study of metabolic and functional anomalies in the human body. Its main property is the generation of images for diagnostic procedure of clinical pathologies. Below are illustrative examples: tomographic image of brain, figure 1, whole body bone image, figure 2, and the third image is from a PT / CT scheme study comprising the fusion of the first two, figure 3.

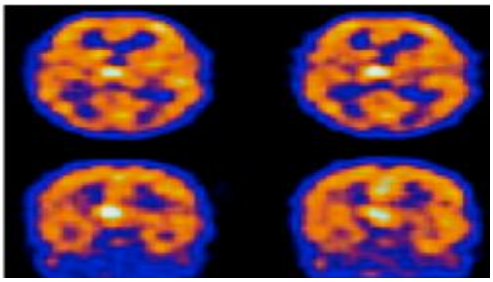

Figure 1. Tomographic imaging of brain study

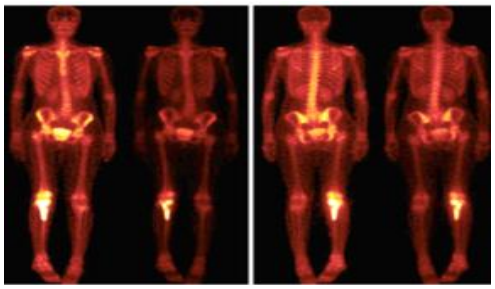

Figure 2. Full-Body Capture Study Image

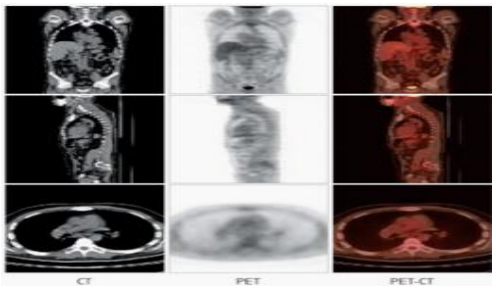

Figure 3. PET / CT system image

In the therapeutic procedure the objective is the use of the radiation emitted by the radiopharmaceutical in an organ of interest, for example, the use of radioiodine Iodine-131, in the treatment of thyroid cancer (MINISTRY OF HEALTH 2017).
Radiopharmaceuticals are chemical compounds, drugs, when attached to a radioisotope are used as therapeutic or diagnostic agents, the first determines the distribution profile around the organs of the body and the latter allows to determine their distribution in the body, (Murray, Peter 1998). The following figure shows some organs and tissues, their respective radiopharmaceuticals and its associated radioactive isotope:

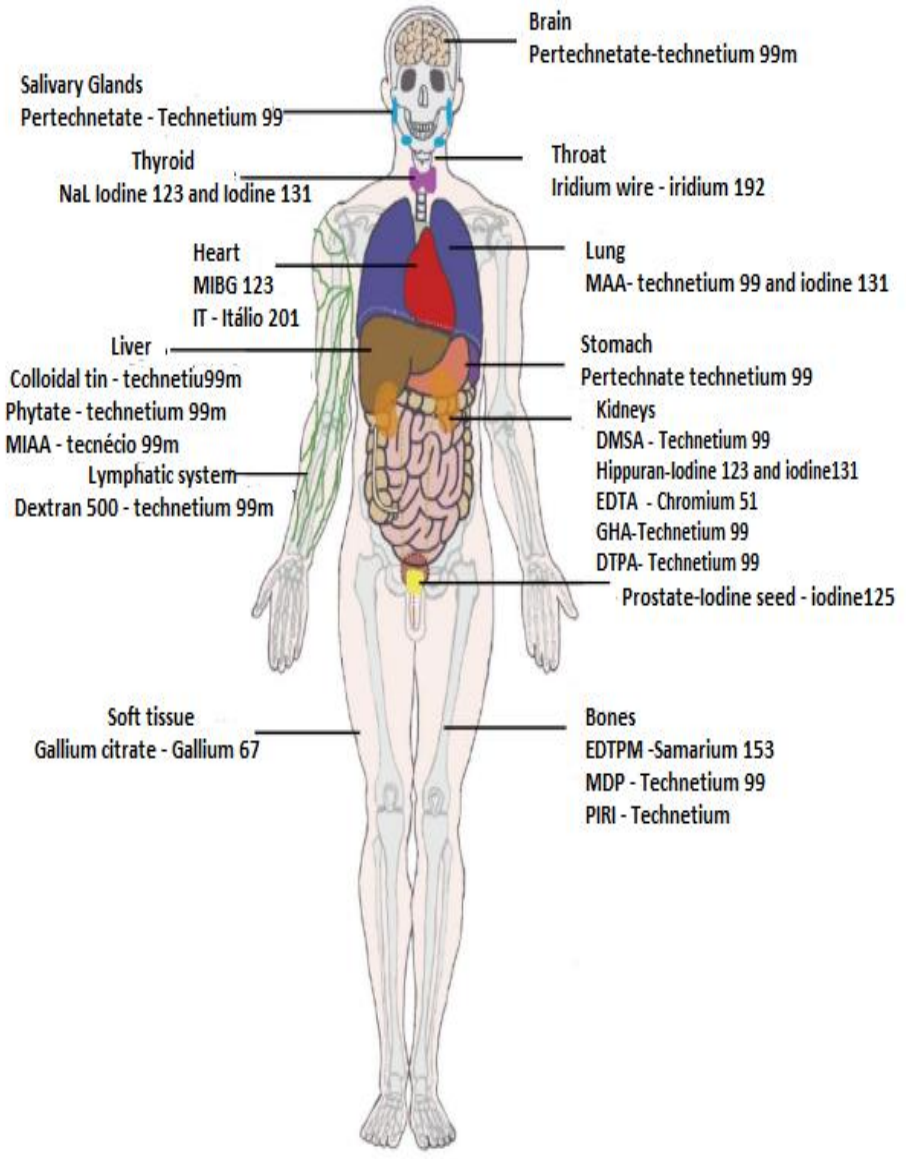

Figure 4. Radiopharmaceutical and its study organs.

Radioisotope is an isotope of a specific element having unstable neutrons number, so that it undergoes spontaneous decay with the release of radioactive particles or energy. Radionuclide is a nuclide of artificial or natural origin that has an unstable configuration that acquires stability through radioactive decay (Murray, Peter 1998). The table below shows some of the main radioactive isotopes used in Nuclear Medicine, indicating the type of emission (type of radiation emitted) and the physical half-life of the radioisotope.

Table 1. Some physical properties of the radionuclides used in nuclear medicine

Radionuclide	Half-Life	Decay Mode	Gamma energy
^{11}C	20,3 min	Positron	511KeV
^{18}N	10,0 min	Positron	511KeV
^{15}O	2,07min	Positron	511KeV
^{67}Ga	3,26days	EC*	511KeV
^{18}F	110min	Positron	511KeV
^{87}Rb	1,25min	Positron	511Kev
^{99}Tc	6,03 days	IT**	140KeV
^{111}In	2,81 days	EC	159 KeV
^{123}I	13,0 h	EC	159 KeV
^{133}I	8,06 days	gamma	364KeV
^{201}Ti	3,05 days	gamma	68-80 KeV, X rays
*EC: electron capture(see[98]) **IT: isometric transition(see[98])			

2.1 Methods

At first a review of the appropriate literature was done and the following articles and regulatory notes were taken into account: Nuclear Medicine in Clinical Diagnosis and Treatment [ref 3], Nuclear Medicine: a Manual for Students and Teachers [ref 4], Norma 3.05 of CNEN [Ref 5], and publications of the Nuclear Safety Series of IAEA [ref 6]. Specific article printed and available on the World Wide Web [ref 1] and [ref 2] were also analyzed and considered. With the knowledge acquired, on-site research was performed in a therapeutic room of the Nuclear Medicine Service, as well as interviews with professionals who work directly with the patients of the unit. We also used records of patient recommendations and observations available to the professionals and their patients [ref 7].

2.2 Results

The information obtained and the studies performed show that the therapeutic room used in radioiodine therapy is a radioactive facility with some particularities that should be presented to the patients in a clear and objective way. For the practice of Nuclear Medicine, it is necessary that the facility be regularly registered in a competent institution, according to the legislation, and medical exposure situations are justified and planned (Bailey, Humm, Pokropek, Aswen, 2014). According to CNEN 3.05, the installations must have concrete walls and leaded door, to keep dose levels for workers and the public within the established limits. Pertinent signalization and areas classifications shall also be observed in accordance with the standards. To make the therapy safer, there must be a patient identification system in order to avoid possible accidents where patients receive double doses, for example. Care should also be taken to avoid exposure of patients who are pregnant or breastfeeding (IAEA).

Recommendations for patients provided by SMN should include, among other recommendations, guidelines such as: after self-dosing the patient should not talk for 30 minutes, drink water only one hour after the application, and feed after two hours. The hygienic care to be followed involves taking two to three baths a day, not walking barefoot around the room, washing hands constantly and never opening the exit door of the therapeutic room during confinement. The communication must be made by telephone. When delivering food, the patient must stay behind the shield. After hospital discharge, the patient should avoid contact with pregnant, children and pregnant and lactating women. He should sleep in a separate bed and keep a minimum distance of 2 meters from other people he live with. These are some examples of the procedures and care needed.

3. CONCLUSIONS

Based on the compilation and analysis of the information collected in the scientific literature, guides and rules, as well as on-site information's, it is expected that a built virtual environment can serve as a source of information and guidance for patients, their families and neighbors about therapeutics, thus acquiring better conditions in terms of radiological protection of those involved.

ACKNOWLEDGMENTS

We thank CNEN, CNPQ and FAPERJ.

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