Assessment of a portable scintillation detector apparatus probe and collimator for thyroid uptake studies

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Keywords: thyroid uptake, instrumentation, Monte Carlo simulation, scintillator detector

Introduction

Nuclear Medicine techniques are widely used in diagnosis and therapy of the thyroid gland. Iodine radioisotope uptake measurement, using ^{131}I or mostly ^{123}I, is commonly employed to evaluate the thyroid functional behavior. One of the most frequently found equipment that performs this task is a Thyroid Uptake System. This equipment consists basically of a radiation detector probe that generates electric pulses whose amplitude varies according to the radiation energy absorbed by the detector and a counting system that counts the pulses that fall in a specific amplitude range. The detector probe is usually composed by a scintillator radiation detector, coupled to a photomultiplier device and associated electronics, and structures for radiation shielding and collimation, as shown in the Figure 1[1]. Its design is essential for the portability and the overall performance of the equipment. In this work, Monte Carlo simulations have been done using MCNPX general code in order to design a detector probe suitable for thyroid radioiodine uptake applications focusing on shielding and collimation structures. The aim is to get a less weight probe and good portability without compromising probe performance.

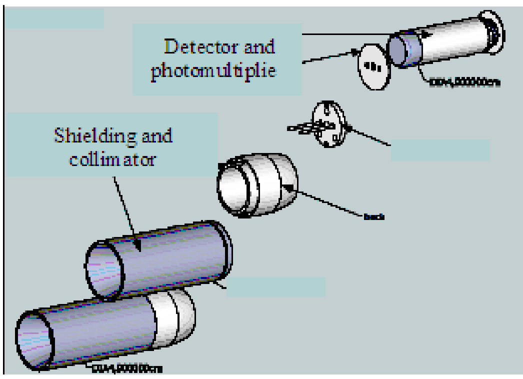

Fig. 1: Thyroid uptake probe for "in-vivo" tests used in Nuclear Medicine Services.

Materials and methods

This work has been performed considering cylindrical model layers to simulate the shielding, collimator and the detector volumes as shown in the Figure 2.

The methodology used for material selection and design of the configuration of the shield and the collimator for thyroid uptake probe is to examine different configurations of the probe through computer simulation. The configuration whose results obtained in the simulations is more suitable to be targeted will be effectively constructed for evaluation of actual performance. At the present stage, probe and phantoms computational models have been developed. Computational simulations, based on Monte Carlo techniques, has been run to study and choose the most acceptable probe configuration to fulfill the intended performance[2]. The graphic in the Figure 3 shows a preliminary result of simulations performed up to now.

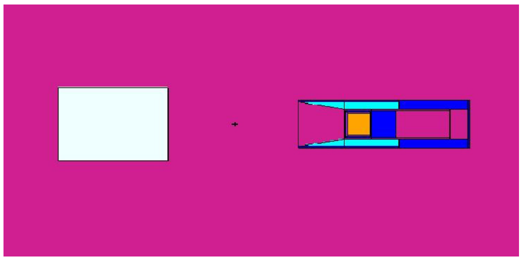

Fig. 2: A preliminary computational model used for simulations.

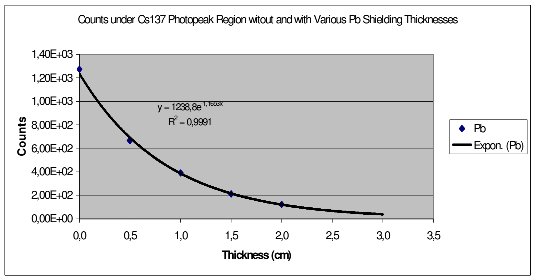

Fig. 3: Dependency of radiation transmitted as function of shielding thickness.

References

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