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Original

Estimation of the collective ionizing dose in the Portuguese population for the years 2011 and 2012, due to nuclear medicine exams

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ABSTRACT

Objectives: In 2009–2010 a Portuguese consortium was created to implement the methodologies proposed by the Dose Datamed II (DDM2) project, aiming to collect data from diagnostic X-ray and nuclear medicine (NM) procedures, in order to determine the most frequently prescribed exams and the associated ionizing radiation doses for the Portuguese population. The current study is the continuation of this work, although it focuses only on NM exams for the years 2011 and 2012.
Material and methods: The annual frequency of each of the 28 selected NM exams and the average administered activity per procedure was obtained by means of a nationwide survey sent to the 35 NM centres in Portugal.
Results: The results show a reduction of the number of cardiac exams performed in the last two years compared with 2010, leading to a reduction of the annual average effective dose of Portuguese population due to NM exams from 0.08 mSv ± 0.017 mSv/caput to 0.059 ± 0.011 mSv/caput in 2011 and 0.054 ± 0.011 mSv/caput in 2012. Portuguese total annual average collective effective dose due to medical procedures was estimated to be 625.6 ± 110.9 manSv in 2011 and 565.1 ± 117.3 manSv in 2012, a reduction in comparison with 2010 (840.3 ± 183.8 manSv).
Conclusions: The most frequent exams and the ones that contributed the most for total population dose were the cardiac and bone exams, although a decrease observed in 2011 and in 2012 was verified. The authors intend to perform this study periodically to identify trends in the annual Portuguese average effective dose and to help to raise awareness about the potential dose optimization.

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Estimación de la dosis colectiva en la población portuguesa de los años 2011 y 2012, debido a los exámenes de medicina nuclear

Palabras clave:
Medicina Nuclear
Población Portuguesa
Dosis colectiva
Dosis efectiva
Dose Datamed II

RESUMEN

Objetivo: En 2009 y 2010 un consorcio portugués ha sido creado para implementar las metodologías propuestas por el proyecto europeo Datamed II (DDM2), con el objetivo de coleccionar datos de procedimientos de radiología de diagnóstico y medicina nuclear (MN) más frecuentes, así como la dosis asociada en la población portuguesa. Este estudio es una continuación del trabajo, que se centrará en los datos de MN para los años de 2011 y 2012.
Material y Métodos: La frecuencia anual de cada uno de los 28 exámenes de MN seleccionados y la actividad media administrada por procedimiento se obtuvieron a través de una encuesta enviada a los 35 departamentos de MN en Portugal.
Resultados: Los resultados muestran una reducción drástica en el número de procedimientos cardiacos en los últimos dos años, lo que tiene como consecuencia una reducción de la dosis efectiva anual en la población portuguesa derivado de procedimientos de MN de 0,08mSv±0,017 mSv/caput en 2010, a 0,059±0,011 mSv/caput in 2011 y 0,054±0,011 mSv/caput in 2012. La dosis efectiva colectiva media en la población portuguesa es estimada en 625.6 ± 110.9 manSv en 2011, y 565.1 ± 117.3 manSv en 2012.
Conclusiones: Los exámenes cardiacos y óseos fueron más frecuentes y los que más contribuyeron para la dosis total de la población, aunque se verificó una disminución en 2011 y en 2012. Los autores de este trabajo pretenden realizar este tipo de estudios periódicamente para identificar tendencias en los diferentes procedimientos de MN y ayudar a aumentar la conciencia de los profesionales de MN sobre este asunto.

Introduction

The use of ionizing radiation for medical purposes has increased over the past decades, contributing to over 95% of man-made radiation exposure.[1] Even if image quality improved, allowing for more accurate diagnoses, a significant increase of the dose delivered to each patient also occurred. Procedures such as computed tomography (CT), interventional procedures, and cardiac nuclear medicine are thought to be the main contributors to such an increase in exposure. International organizations such as the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the European Commission (EC) published several reports in which increased values of worldwide collective dose are presented.[2,3] The EC has concerns about the wide differences between the reported results of population dose estimations from different European countries with similar healthcare levels, which may be due to the absence of a common European methodology. This led to the creation of a multinational European project, in 2004, the Dose Datamed I (DDM1), in which a group of countries with tradition in conducting studies of population exposure participated, with the aim of finding a common methodology. Based on the experience of 10 European countries, Radiation Protection no. 154 was created.[4] This document provides practical guidance to create a harmonized system for assessing patient doses in Member States in order to compare national population doses in the future. Guidance is provided to assess dose due to medical X-ray imaging and nuclear medicine (NM) procedures. It should be noted that there has been a long history of carrying out periodic reviews of the population exposure in most countries participating in DDM I, in contrast with what happens in Portugal.

In 2009–2010 the European Commission financed the project Dose Datamed II (DDM2),[5] a follow-up study of DDM1, also called "Study on European Population Doses From Medical Exposure", aiming to collect data from diagnostic X-ray and nuclear medicine procedures in order to determine the most frequently prescribed exams and the associated collective doses in the European population.[6] Portugal, together with other 35 countries participated in this study.[7] For such, a Portuguese consortium was created, to potentiate the implementation of the methodologies proposed by DDM2.[8] This led to an estimation of the dose to the Portuguese Population of $\sim$1 mSv caput^{-1} for the year 2010 and, of particular interest to this work, of 0.080 ± 0.0017 mSv/caput due to nuclear medicine examinations.[9]

The current study aims to be both a continuation and an improvement of the previous work, focusing only on the population doses to nuclear medicine procedures, for the years 2011 and 2012, and comparing them with the results obtained in 2010. Radiation doses due to radiodiagnostic exams will be analyzed elsewhere. The most frequent nuclear medicine exams and those that contribute the most for the annual collective dose were assessed. The Portuguese results are also compared with those available for other European Countries. Finally, the yearly trends of population dose and annual frequencies of different nuclear medicine exams were also analyzed.

Material and methods

The methodology used in this study was based on the report Radiation Protection 154 (RP154). For nuclear medicine practices, the RP154 recommends the implementation of a nationwide survey to the extant nuclear medicine centres.[4] A table with the most common nuclear medicine procedures is proposed in the report, involving the most utilized radionuclides divided in six major types of diagnostic exams (bone, heart, thyroid, lung, kidney and the remainders). This consists of 28 NM examinations (procedure, radionuclide and chemical form) as presented in Table 1.

A nationwide survey was sent to all 35 nuclear medicine centres in Portugal. The centres were invited to fill in a file with the annual frequency of each exam, as well as the average administered activity per procedure. In addition, each NM centre could include a list of exams they considered relevant (high number of patients performing the exam or high administered activity). For the NM centres which had this information available, only data from adults (>18 yrs) were included. In Portugal, a total of 34 NM departments were identified in 2011 and 35 in 2012, unlike the 32 centres in 2010. The use of different radionuclides highly affects the effective dose per examination, so it is important to guarantee the same radionuclide is being used for the same procedure.

Of the 34 identified centres in 2011, four did not possess any statistical data and the other six did not reply. In 2012 from the universe of 35 centres, four did not possess any statistical data and