International Joint Conference Radio 2019

Dose risk assessment in computed tomography

Lima[a] G. I. O.A., Sá[b] L. V., de Andrade [a] E. R., Paula[a] V. M.

[a]Universidade Federal do Rio de Janeiro, COPPE/PEN/UFRJ, Rio de Janeiro

[b]Instituto de Radioproteção e Dosimetria, IRD/CNEN, Rio de Janeiro

[c] Instituto Militar de Engenharia, Seção de Engenharia Nuclear, IME/SE7, Rio de Janeiro

gabianchietaa12@gmail.com

Introduction: In medicine, the use of ionizing radiations in radiodiagnostic exams is part of the clinical routine. This application of radiation sources has been increased in the last decades attributed to the development of detection systems and faster computational methods of image processing. In this way new technologies for the early diseases detection arise, as well as neoplasm treatment. The use of ionizing radiation in Medicine occupies a favorable space in applications of radioactive materials capable of favoring the evaluation of metabolic alterations, producing images and also performing treatment of diseases by new therapeutic procedures. However, the potential side effects that may occur due to exposure of the population to ionizing radiation (CUNHA, 2005), which leads to an increase in the collective dose resulting in the world population, should be considered [1].

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was established by the United Nations General Assembly in 1955 to assess and report on the effects of all sources of radiation. Ionizing radiation in the most diverse practices. The main objective of the Global Survey proposed by UNSCEAR was to estimate the overall collective effective dose resulting from the medical use of radiation. Surveys are also used to identify gaps in treatment capacity and possible unjustified dose variations for the same radiological procedure in different countries [2]

It is designed to assess medical exposures and provide guideline levels for each procedure, the International Radiation Protection (ICRP) has defined the term Diagnostic Reference Level (NRD) [2]. In principle, NRDs are applicable in the areas of radiodiagnosis and treatment with the use of ionizing radiations. Doses may be unnecessarily high because of lack of attention, indifference, or too much work pressure, although they may also sometimes be attributed to the individual reluctance of the operator to accept standard procedures. The application and analysis for the NRDs can encourage changes in procedures showing what is possible in other workplaces and departments [3]. There are published studies that have reported the importance of being attentive to the increased risk of induction of various diseases caused by exposure to ionizing radiation, even at low doses. Thus, health sectors that are directly related to this type of exposure need to have an effective control of the doses delivered in each procedure in order to guarantee the lowest possible risk considering each case [4].

Methodology:

The Radiation Risk Assessment Tool (RadRAT), developed by the US National Cancer Institute (NCI) is a Risk Assessment tool for exposure to radiation and acts as an online calculator to estimate incidence risk (Or countries with similar cancer incidence rates) from exposure to ionizing radiation at doses below 1 Gy [8].

The software provides estimates of absorbed doses in specific organs, according to age at the time of exposure andsex. The risk of lifetime total cancer induction and risk estimates for specific organs are reported together, with uncertainty of 10%. Life-long risks are based on models for the 11 types of cancer included in the 2006 BEIR VII Committee report and also on the risk models for eight other cancers developed by NCI resulting from post-publication surveys Of the BEIR VII report [8].

The risk models used are based on the BEIR VII Committee to estimate the risk of life for the population after exposure to radiation, considering eleven specific types of cancer: stomach, colon, liver, lung, breast, uterus, ovary, prostate, Bladder, thyroid and leukaemia. New risk models were also developed for seven types of cancer: oral, oesophagus, gallbladder, pancreas, rectum, kidney and brain / central nerve. After exposure, the risk of radiation-related cancer may be noticed for at least fifty years in the life of annex posed person[8].

BEIR VII developed the relative excess risk (RER) models for the relative variation of exposure rates, and the absolute excess risk (EAR) model for the absolute difference in exposure rates and for non-exposed individuals. For solid cancers it is considered a linear relationship with the dose that depends on sex and age at the time of exposure. RadRAT calculates the risk attributable to the exposure time to the end of the expected lifetime. In addition, the calculator provides estimates of future risk, which is defined as the risk from the present time to the end of the expected lifetime. The additional risk is considered on future risks, baseline risk (i.e. risk in the absence of radiation exposure) and total risk (i.e., excess plus baseline). The risk of single or multiple exposures and the individual risk of each exposure can be determined by calculations. For each type of cancer a risk is calculated, and the total risk is obtained as the sum of the risks of all types of cancer. The number and exposed organs or tissues may vary from exposure to exposure [8].

Conclusion:

The present study aimed to develop some tools for dose and risk estimates in diagnostic radiology exams. Thus, to suggest a methodology for establishing reference levels for CT scan. To do so, spreadsheets with collected data were elaborated, according to each methodology of estimation of absorbed dose, effective, of entrance in the skin, descriptors of dose, according to the type of equipment and exam studied.

References:

[1] CUNHA, ALL et al., **Avaliação de doses nos órgãos de pacientes submetidos aexames de radiologia convencional no Rio de Janeiro**, Anais da 57ª Reunião Anual da SBPC, Fortaleza, 2005.

[2] ICRP, Internactional Commission on Radiological Protection, "**Recommendations of the International Commission on Radiological Protection**," em *Publication 103*, 2007.

[3] COMISSÃO EUROPÉIA, **Protecção contra as radiações — Orientações relativas aos níveis de referência de diagnóstico (NRD) para exposições médicas**. Luxemburgo: CEC, 1999.

[4] UNITED NATIONS SCIENTIFIC COMMITEE ON THE EFFECTS OF ATOMIC RADIATION, UNSCEAR, Report of UNSCEAR, 56th session, 2008.

[5] MADRIGANO, RR et al., Avaliação **do conhecimento de médicos não radiologistassobre aspectos relacionados à radiação ionizante em exames de imagem**, RadiolBras, , vol.47, no.4, p.210-216, Jul 2014.ISSN 0100-3984

[6] IMPACT/CT ImpactDose - CT dose estimation made easy. Disponível em <http://www.ct-imaging.de/en/ct-software-e/impactdose-e.html> acessado em 2016.

[7] AAPM Report n° 204**. Size Specific Dose Estimates (SSDE) in Pediatric and Adult Body CT Examinations**.

[8] GONZALEZ, deB.; VEIGA, A. A.J; RAJARAMAN, P.; THOMAS, B.; HOFFMAN, F. O; GILBERT, E. LAND, C., RadRAT: **A radiation risk assessment tool for lifetime cancer risk projection**. 2012.

[9] DATASUS. Ministerio da saúde. **Cadastro nacional de estabelecimentos de saúde**. Rio de janeiro, RJ 2016. Disponível em:< http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sia/cnv/qauf.def> acessado em 2016.

[10] CAPEVERDE, S. A. **Relação entre a estimativa de dose de radiação em pacientes submetidos a exames de tomografia computadorizada do abdômen e o índice de massa corporal**.