Study of two different radioactive sources for prostate brachytherapy treatment

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In this study we evaluated two radioactive sources for brachytherapy treatments. Our main goal was to quantify the absorbed doses on organs and tissues of an adult male patient, submitted to a brachytherapy treatment with two radioactive sources, produced at the Instituto de Pesquisas Energéticas e Nucleares (IPEN/CNEN-SP). The IPEN is a research institute responsible for the production of several radioactive materials employed in medicine, industry and research. The first source that we evaluated was a ^{192}Ir radioactive source, which is a cylinder with 0.09 cm in diameter and 0.415 cm long. It is composed of a nucleus of ^{192}Ir (0.065 cm in diameter and 0.295 cm long) surrounded by platinum. The nucleus is composed of 25% of iridium and 75% of platinum. The second source evaluated in this work was a ^{125}I radioactive source. This source is also a cylinder, with 0.08 cm in diameter and 0.45 cm long. It is composed of a thin layer of titanium (0.05 mm thick), and the ^{125}I (0.05 cm in diameter and 0.30 cm long) is adsorbed in silver. To evaluate the absorbed dose distribution on the prostate and other organs and tissues of an adult man, under a prostate brachytherapy treatment, a male virtual anthropomorphic phantom MASH, coupled in the radiation transport code MCNPX 2.7.0, was employed. We simulated 100 radioactive sources of ^{125}I and one of ^{192}Ir, inside the prostate, as normally used in these treatments. To evaluate the results of each type of source, each treatment was simulated separately. This new approach presents the advantage of determining the absorbed doses on organs far from the target volume. This phantom was developed by the Computational Dosimetry Group of the Nuclear Energy Department of the Federal University of Pernambuco, Brazil (UFPE). It was based on a mesh surface using male physiological and anatomical data, with 140 organs and segmented tissues, with dosimetric significance. As this phantom was developed in a supine position, the displacement of the internal organs of the chest, compression of the lungs and reduction of the sagittal diameter were all taken into account. We consider that these conditions will lead us to more precise results in relation to those results obtained with mathematical anthropomorphic phantoms. For the ^{192}Ir, the higher doses values were obtained for the prostate and surrounding organs, as the colon, gonads and bladder. Considering the ^{125}I sources, with photons with lower energies, the doses to organs that are far from the prostate were lower. All values for the dose rates are in agreement with those recommended for brachytherapy treatments. Besides that, the new seeds evaluated in this work present usefulness as a new tool in prostate brachytherapy treatments, and the methodology employed in this work may be applied for other radiation sources, or treatments.