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CLINICAL DOSEMETERS CALIBRATED IN TERMS OF AIR KERMA AND ABSORBED DOSE TO WATER (*)

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1) Introduction - The procedures recommended by the IAEA Code of Practice were applied at the Calibration Laboratory of São Paulo in order to provide in the future the clinical dosemeters users with absorbed dose to water calibration factors for ^{60}Co radiation beams. In this work the clinical dosemeters were calibrated free in air and in water, and the results were compared, using conversion factors.

2) Materials and Methods - The secondary standard dosemeter consists of an ionization chamber (NE model 2561), an electrometer (NE model 2560) and a radioactive check source (NE model 2562). Its calibration factors are given in terms of exposure in air (NPL). This system participates annually of the national intercomparisons organized by the brazilian Secondary Standard Dosimetry Laboratory (SSDL)Rio de Janeiro). The experiments were all performed in ^{60}Co radiation beams (12 TBq) and the substitution technique was applied. The several tested clinical dosemeters of different manufacturers and models belong to the laboratory and to hospitals. For the measurements in water the IAEA cubic water phantom was used.

3) Results - The dosemeters were all calibrated free in air in terms of air kerma, and the calibration factors in terms of absorbed dose to water were obtained through conversion factors. The same dosemeters were also calibrated into the water phantom. Good agreement was found between the two methods; the differences were always less than 0.5%.

4) Conclusion - The data obtained during this work show that when the dosemeters are used only in ^{60}Co radiation and the users apply in the hospital routine work the IAEA Code of Practice, the calibration can be performed directly in the water phantom. This procedure provides the useful calibration factors in terms of absorbed dose to water.

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EVALUATION OF UNCERTAINTIES IN ABSORBED DOSE DETERMINATION IN ELECTRON BEAM

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In radiotherapy, the difference between the prescribed dose and the delivered dose to the patient occurs at different levels. In the physical part, it arises in the measurement of the absorbed dose at the reference point in a water phantom and in measurements of the dose distribution.

This work evaluates the uncertainties linked to the calculation of the absorbed dose in therapeutic electron beam. Following the recent development in the concept of the uncertainties, we estimate, step by step, the total uncertainty on the absorbed dose determination measured with two different ionization chambers in 13 MeV electron beam.

From the primary laboratory to the hospital, we check the possible derivations in the numerical expression of the absorbed dose measured at the reference point in water and the correlated uncertainties. At this step, the uncertainty on the transfer of Kerma in air (K_n) from the laboratory to the hospital is given as ± 0.6 % for cylindrical chamber (0.6 cm^3). In application of the french protocol, the uncertainty on the absorbed dose in air cavity of the ionization chamber, is estimated as ± 0.8 % for the same chamber. The uncertainty on the absorbed dose at the reference point to water, given as one standard deviation in the combined uncertainties, is estimated as ± 1.4 % for the cylindrical chamber. It is of ± 1.3 % for a flat chamber (0.04 cm^3) with k=1.
From the reference conditions to another, we estimate the uncertainties in any point of the central axis and the possible systematic errors. With the cylindrical chamber the uncertainty can raise 2,1 % at the half dose depth (R50) and 1,85 % for the flat chamber, with k=1. At the same depth (R50) the systematic error could be + 5,8 % on the absorbed dose measured with a cylindrical chamber if we are neglecting the variation of some parameters with the depth, such recombination and polarity effects and + 7.5 % with the flat chamber.

In conclusion, to get a better precision in the measurement of the absorbed dose for a clinical application we must do a careful choice of material, examine very mindfully all the physical and dosimetric data and consider the variation of all energy dependant parameters.