APPLICATION OF A DOSIMETRIC SYSTEM FOR CALIBRATION OF $^{90}Sr+^{90}Y$ SOURCES USED IN BRACHYTHERAPY

ANTONIO, P.L., CALDAS, L.V.E.
Instituto de Pesquisas Energéticas e Nucleares, Comissão Nacional de Energia Nuclear, IPEN-CNEN/SP, São Paulo, SP, Brazil. patrilan@ipen.br

Introduction: The thermoluminescent technique has been used for calibration and dosimetry of $^{90}Sr+^{90}Y$ sources used in brachytherapy, also called clinical applicators. TL dosimeters present usefulness for several applications (Soares, 2002) e advantages as easy handling and simple readout (Olko, 2010), for example, therefore they are useful as detectors of ionizing radiations. International recommendations (IAEA 2002, ICRU 2004) presented the importance of the calibration of these sources, as part of a quality control program for brachytherapy. Although these sources are not anymore commercialized, they are still in use in several Brazilian radiotherapy clinics. Oliveira and Caldas (2007) showed that thin $CaSO_4$:Dy pellets are useful for the calibration of $^{90}Sr+^{90}Y$ clinical applicators.

Antonio and Caldas (2009) developed a postal dosimetric system for calibration of $^{90}Sr+^{90}Y$ dermatological and ophthalmic applicators of radiotherapy clinics of São Paulo city. The objective of this work was to apply the dosimetric system at these clinics, as a training program of the clinical applicator operators, and to calibrate the sources.

Materials and Methods: The dosimetric system was developed using thin thermoluminescent dosimeters of $CaSO_4$:Dy, with 6.0 mm of diameter and 0.2 mm of thickness, produced at the Dosimetric Materials Laboratory of IPEN. During this work, the operators of the clinical applicators at several clinics were trained about how to use the dosimetric system.

A $^{90}Sr+^{90}Y$ source of the secondary standard system of Buchler GmbH & Co., BSS1, Germany (1850 MBq, 1981) was utilized for the reproducibility study of the TL pellets. A $^{90}Sr+^{90}Y$ clinical applicator, calibrated at the American primary standard laboratory of National Institute for Standards and Technology (NIST), called therefore NIST applicator, was used for the irradiations as reference source.

During the calibration procedure, the TL pellets were exposed to different $^{90}Sr+^{90}Y$ applicators of the clinics; for this procedure, five PMMA supports with dimensions of 5.0 cm of diameter and 1.0 cm of thickness were utilized. The distance used between each sample and each source was null.

The TL measurements were obtained using a Harshaw TLD Reader model 3500, with light emission integrated in the temperature interval between 180ºC and 350ºC. All TL measurements were taken after the irradiations; afterwards, the pellets were thermally treated at 300ºC during 3h for reutilization.

Results: Although the postal dosimetric system has a calibration procedure, it was very useful to show the calibration steps to the operators, to ensure the correct use of this system. Furthermore, this routine procedure was a form of introducing the system in the quality control program of the clinics.

The characterization of the $CaSO_4$:Dy pellets was realized in relation to a reproducibility study of TL measurements to beta radiation of $^{90}Sr+^{90}Y$, and determination of the lower detection limit. A dose response curve using the NIST applicator was obtained, as the standard system (reference) in the calibrations of the clinical applicators. The TL response of the pellets was obtained in the dose interval between 5 and 20 Gy. Calibration factors were obtained for the $CaSO_4$:Dy dosimeters.

Eight radiotherapy clinics of São Paulo were visited. The TL measurements were taken at these places, using the dosimetric system and different clinical applicators. The TL pellets were evaluated at the Calibration Laboratory of IPEN. The absorbed dose rate for each clinical applicator was obtained, and a calibration certificate was emitted.

Conclusion: During the visits to the clinics, the calibration procedure of the $^{90}Sr+^{90}Y$ sources was explained and then the dosimetric system was applyed. The results obtained for the dosimetric characterization of the thin $CaSO_4$:Dy pellets were satisfactory. The absorbed dose rates presented similar values to the values provided in the calibration certificates of the clinical applicators. Therefore, it can be concluded that the dosimetric system can be used by the radiotherapy clinics in São Paulo city and hopelessly later by all Brazilian clinics, in the form of a postal dosimetric system.

References:

Antonio, P.L. and Caldas, L.V.E. 2009, Book of Abstracts, Primeiro Congresso de Proteção contra Radiações de Países e Comunidades de Língua Protuguesa, Lisbon, 24-27 November.

International Atomic Energy Agency (IAEA) 2002, TECDOC-1274, Vienna.

International Commission on Radiation Units and Measurements (ICRU) 2004, v.4, n.2, Report nº 72, Geneve.

Oliveira, M.L. and Caldas, L.V.E. 2007, NIMA 580, 293-295.
Olko, P. 2010, Radiat. Meas. Article in press, 1-6.
Soares, C.G. 2002, Radiat. Prot. Dosim. 101, 167-171.