Probes and well counter in clinical dosimetry: common practice and clinical applications

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"Dosimetry" means measurement of the dose, i.e. of the energy released to a tissue. This is an indirectly measureable quantity dependent on administered activity, morphologic characteristics of the studied tissue (mass, shape, dimensions), its radiotracer uptake and effective half-life (kinetic parameters). The only quantity easily measurable in any nuclear medicine department is activity so, even in the recent past, it was used to neglect the tissue specific characterization administering standard therapeutic activities. A patient specific pre-treatment dosimetric study allows us to determine the activity necessary to release the desired dose to the therapy target and/or to calculate the maximum activity that can be administered without damaging critical organs such us bone marrow, kidneys or bladder. A post-therapeutic dosimetric study allows us to determine the dose really released to the tissues of interest.

The basic relationship for dosimetry is the MIRD expression: D=Ã*S where S is the Snyder factor depending on the radionuclide and on tissue shape and dimensions and Ã is the cumulated activity (the area under the time-activity curve). For any dosimetric study it is necessary to acquire multiple experimental points (for example activity in blood samples, in the whole body or in a region of interest) at different times to describe the radiotracer kinetic; their numerosity and time position must be set by an optimized protocol.

Measurements of: - biologic samples must be performed with a well-counter detector calibrated to convert the counts-per-minute in Bq/ml; - the activity in the whole body of the patient can be performed with a probe using a fixed geometry and acquiring conjugate view (anterior and posterior) to reduce the measurement dependence on the redistribution of the tracer inside the body; - for analysis of regions of interest imaging systems are necessary.

All the details about the measurements (biologic sample volumes, sampling time, geometrical conditions, etc.) must be clearly described in operative protocols. Measurements performed after therapeutic administration may increase radiation protection problems and must be accurately planned. All these actions require the involvement of a multidisciplinary staff: physicians, physicists, nurses and technologists whose role can be different according to each country regulation.

References

1. Lassmann M, Hanscheid H, Chiesa C, et al. EANM Dosimetry Committee series on standard operational procedures for pre-therapeutic dosimetry I: blood and bone marrow dosimetry in differentiated thyroid cancer therapy. Eur J Nucl Med Mol Imaging 2008; 35:1405-1412.
2. Stokkel M, Handkiewicz-Junak D, Lassmann M, et al. EANM procedure guidelines for therapy of benign thyroid disease. Eur J Nucl Med Mol Imaging 2010; 37:2218-2228.
3. Lassmann M, Chiesa C, Flux G, et al. EANM Dosimetry Committee guidance document: good practice of clinical dosimetry reporting. Eur J Nucl Med Mol Imaging 2010.