

Dose-Response Correlation is Possible in Radioiodine Therapy of Hyperthyroidism

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Abstract

Radioiodine therapy of hyperthyroidism is an established treatment modality, alternative to surgery and iodine isotope I-131 has been used in nuclear medicine for several decades to treat both benign and malignant thyroid diseases. Initial studies have recognized that the effect of radiation on healthy or malignant tissue depends on the amount of radiation delivered. A dosimetric approach to iodine therapy for hyperthyroidism can allow a lower iodine dose administration and a lower manifestation of side effect like hypothyroidism. Despite that many clinicians consider dosimetry in thyroid application of dubious importance. Possibility of dose-response correlation is here discussed.

Keywords: Hyperthyroidism; radioiodine-131I; nuclear therapy; dosimetry

Treatment with radioactive isotopes has been the first clinical application of Nuclear Medicine, when the Phosphorus-32 was used for polycythemia and some forms of leukemia[1,2], and subsequently the administration of iodine-131 was adopted for the therapy of thyroid disease[2,3], in the early '40s.

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Initial studies have recognized that the effect of radiation on healthy or malignant tissue depends on the amount of radiation delivered. More than 10 years before the development of the gammacamera, great efforts were made to calculate the absorbed doses (in Gy) delivered to healthy and sick tissues[3].

Dosimetric treatment optimization is recommended for 131-I therapy of hyperthyroidism and patient-specific dosimetry is by now a common approach in radioiodine therapy of hyperthyroidisms. The radioiodine administration must correspond to the dose prescribed by the clinician, accounting for the

target mass (autonomous nodules or goiter) and bio kinetics. To reduce side effects like hypothyroidism, target mass reduction during irradiation and dosimetry for the non-pathologic thyroid tissue should also be involved[4].

The customization of the therapy is applied in order to limit the activity administered to the minimum quantity necessary to successfully treat diseased tissues, minimizing the exposure to healthy organs. This requires the execution of a dosimetry carried out by measuring the individual kinetics of iodine[5].

The EANM dosimetry committee recommends the optimization of treatment by means of pre-therapeutic dosimetry based on the evaluation of individual 131I kinetics in the target tissue, after the administration of a tracer activity[6].

Despite the fact that the use of pre-treatment dosimetry has shown the possibility of obtaining better results, even minimizing the appearance of undesired secondary effects, such as hypothyroidism or the need for repeated radioiodine administration, many clinicians still consider specific dosimetry for patients of dubious importance in this context, arguing that

the empirical methodologies or the administration of fixed activities show an analogous efficacy, saving time for pretherapeutical studies[7].

The possibility of establishing a dose-response correlation was investigated by us, highlighting the added value of the patient's specific dosimetry in radioiodine therapy of hyperthyroidism due to nodular thyroid disease[7].

In 374 patients suffering from autonomous thyroid nodule and multinodular goiter of which 187 treatments with an empirical methodology, not based on a pre-treatment dosimetric study and 187 treatments based on dosimetry, the specific dosimetry of the patient has been shown to increase therapeutic efficacy, thus reducing the frequency of recurrence and the need for repeated treatments[6]. The probability of recurrence was measured at 9.6%, exactly half of that associated with the empirical treatment group[7].

According to some authors, a targeted absorption dose of 60 Gy to the thyroid may delay the onset of hypothyroidism in about a quarter of patients with Graves' disease. A dosimetric approach would mean that almost two-thirds of patients could receive an average of three to five times less than conventional radioiodine fixed radiation activity of 370-550 MBq[8].

Good dose-response relationships have been found in some studies with advanced dosimetric concepts. However, the individualization of radioiodine therapy in the treatment of thyroid disorders is not yet fully exploited: remarkable improvements in dosimetry can be obtained from modern imaging techniques, such as SPECT / CT and PET / CT, which enable a three-dimensional measurement of dose distributions[5].

Radioiodine treatment offers the opportunity to fully exploit the potential of an individualized approach to treatment in a way that significantly benefits the patient, in a nascent age of personalized and precision medicine. A correct dosimetric evaluation is therefore the basis for evaluating the efficacy of the treatment with ionizing radiation, allowing to evaluate the efficacy of the treatment and the side effects due to the irradiation of healthy tissues[9].

However, the evidence implies a strong correlation between the delivered absorbed doses and the

response and toxicity, indicating that personalized treatments based on dosimetry would improve the result[10].

We therefore fully agree with Chiesa et al.[11] when they say: *we propose that the package insert of any radioactive agent for therapy should indicate, in parallel with conventional posology, a dosimetry-based administration undertaken under the full responsibility of the therapy team.*

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