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EDITORIAL

New opportunities for dosimetric approach in patients with differentiated thyroid cancer

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In the adult population, the differentiated thyroid cancer (DTC) is the most frequent endocrine neoplasm [1].

According to the American Thyroid Association (ATA) guidelines, in intermediate and high-risk DTC patients, the cornerstone treatment after surgery remains radioactive iodine (RAI) therapy [1–3]. The RAI treatment can be performed with three different main goals: (1) for the remnant ablation in patients without evidence of thyroid residual and for a primary staging at post-therapy whole-body scan (WBS); (2) as adjuvant therapy, to reduce the risk of recurrence in patients with unproven disease; and (3) metastatic treatment in patients with suspected or known DTC secondary lesions [1–3].

In pediatric patients, DTC generally is rare and showed a more aggressive behavior. On the other hand, the DTC lesions are typically highly RAI avid with an excellent response to ^{131}I therapy [4–6].

In DTC patients with metastases, or in those with biochemical or structural recurrence of disease, it may be appropriate to repeat RAI treatment [1–3, 7–9]. Therefore, it is mandatory to preserve the most radiosensitive tissues, including the bone marrow, kidneys, spleen, and salivary glands, and reduce the complications related to multiple radiation exposure. Moreover, in younger patients with a larger life expectancy, the potential risk of second primary malignancies has not been fully demonstrated, but also this aspect should be considered [10, 11].

Currently, the dosimetric approach is based on the optimization of administered ionizing radiation to both target and healthy tissues [12–14]. The goal of dosimetry is to increase the therapeutic effect reducing the exposure to the healthy organs. In patients who underwent RAI therapy, a severe monitoring of organ adsorbed doses would be necessary, especially in patients which more RAI treatment has been indicated.

Generally, the dosimetry is not routinely performed in DTC patients, and the iodine 131 is administered at fixed activity ranging from 1.1 and 3.7 GBq [1, 12–14].

In this background, we read with great interest a paper recently published by Taprogge et al. [15] that describe the results from the multicenter multinational Horizon 2020 MEDIRAD project. This observational study analyzed the adsorbed dose to the healthy organs in 105 DTC patients treated with RAI at fixed activities of 1.1 or 3.7 GBq. The patients were enrolled from four different imaging centers. The images have been acquired by single photon-emission computed tomography (SPECT)/computed tomography (CT) that combines anatomical and functional imaging [16]. The enrollment criteria for each patients were the availability of SPECT scan acquired between 24 and 96 h post-RAI administration (up to five) and of a CT for attenuations correction and Monte Carlo absorbed dose calculations. Moreover, retention dose activity measurements were performed for up to 4- or 7-day post-RAI administration.

Two different teams have analyzed these data by using two different software. The first team performed the dosimetry calculations using the OpenDose3D project, and the following organs were segmented by 3DSlicer software: the neck, lungs, salivary glands, bone marrow, spleen, urinary tract, and bladder. The imaging data were quantified using the volume of interest (VOI) summing the adsorbed dose contained in individual voxels in the respective VOI. The Monte Carlo system was used to derive the voxel-based data and fitted dose rates for each time point. Otherwise, the second team performed the adsorbed dose calculations using in-house dosimetry software in 3DSlicer. Images data were quantized, and the area under the time/activity curve was fitted by multiple time point. The RAI median adsorbed dose administered to healthy, and target organs by rhTSH stimulation and thyroid hormone withdrawal (THW) were reported.

The ranges of absorbed doses to the salivary glands, lungs, and bones resulted to be comparable between two centers (2 and 4), while differences in the estimated doses to salivary

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glands in centers 1 and 3 resulted slightly different due to different acquisition modalities. Interestingly, the results obtained by the two different software in a single center for salivary glands showed a good agreement. The difference in WBS absorbed doses between rhTSH and TWH patients was not significant.

In their results, the authors reported normal and large ranges of absorbed dose to healthy organs including the salivary glands and bone marrow, and the whole-body absorbed doses appear to scale linearly with activity. The results from this multicenter study suggest that the dosimetry may help in optimized and personalized RAI treatment in DTC patients [15]. However, the differences related to the acquisition protocols, cameras, and therapy planning among different realities might affect the dosimetry estimation. Despite these differences can be only partially reduced, the collection of data from different centers can be performed. The optimization of acquisition protocols, including the definition of the optimal time points and the availability of range doses corrected for potential confounding factors, will help in make this approach more friendly and widely used. The conclusion of this important multicenter study could help us lay solid foundations for a dosimetric approach in DTC patients, but these objectives require new and further multicenter studies [15].

Declarations

Ethical approval Institutional Review Board approval was not required because the paper is an editorial.

Consent to participate Not applicable.

Conflict of interest The authors declare no competing interests.

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