Influence of Bone Metastases in the Red Marrow ^{131}INa Internal Dosimetry

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Abstract

This research analyses the evaluation of the absorbed dose in the bone marrow for developing a calculation formalism, based on MIRD methodology, to take into account the influence of bone metastases in patients treated with ^{131}INa due to thyroid differentiated cancer (DTC).

A methodology of image processing is stated for later quantification purposes. The dose contribution, mainly electronic, from trabecular bone and cortical bone to red marrow is considered and a general equation is developed to add that contribution.

The biodistribution of active bone marrow in adults bone regions is considered from different studies (Cristy (1981), ICRP 70 (1995), Bouchet et al. (2000), ICRP 89 (2004)). It is assumed that the 60% of red marrow is in the axial skeleton, 25% in ribs, femoral head, proximal portion of chimney and breast bone, and 10% in skull and scapula. Accordingly to this distribution, the bone regions with more percentage are included to calculate the influence in the red marrow absorbed dose.

The absorbed dose in bone marrow is calculated considering 4 sources: bone marrow, bone tissue with metastases, rest of the bone tissue without metastases and rest of soft tissue.

Conversion factors for fifteen regions of the skeleton, obtained from Eckerman Monte Carlo simulations, were used to calculate absorbed dose in each region of bone.

The absorbed dose from this formalism is based on specific biokinetic data from patients and dosimetric models. It was considered of interest to compare the results with the biological dosimetry in parallel. From this biological method, the accumulated absorbed dose from previous therapies and also the bone marrow absorbed dose due to the last radiodiodine treatment can be obtained in order to compare dose assessment results between the developed formalism and biological dosimetry.

The results obtained with the proposed formalism, show that lesions in some bones regions contribute more to the absorbed dose than lesions in other regions and that bone metastasis can increase significantly (23% in this study) the red marrow absorbed dose. Therefore, it is actually important to consider bone metastases in internal dosimetry formalism for DTC patients. In addition, bone marrow absorbed dose calculated with the developed

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formalism is consistent with the results obtained with biological dosimetry (Fluorescence In Situ Hibridization and Conventional Citogenetic).

KEYWORDS: Bone metastasis, red marrow absorbed dose, MIRD, biological dosimetry.