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Dosimetry in Molecular Radiotherapy: Trials, Tribulations and Transcendence

Dosimetry for radiopharmaceuticals has had chequered path. Initial treatments of benign thyroid disease and thyroid cancer entailed efforts to estimate the level of uptake in the thyroid gland or thyroid remnants, on the understanding that the main factor to determine outcome was not the level of activity administered but its biodistribution. A formalism for dosimetry was presented by Leo Marinelli in 1948, but the wide therapeutic window of radioiodine generally rendered routine dosimetry at the time as unnecessary and impractical, and it has remained a subject of research rather than clinical application. As molecular radiotherapy now experiences an unprecedented rate of growth with an increasing range of radiotherapeutics for common as well as rare cancers, and as technology and methodology continue to develop, there is now a need to translate internal dosimetry into routine clinical practice to improve clinical and cost effectiveness, particularly for new agents such as Lu-177 PSMA for the treatment of bone metastases from prostate cancer. There is now an abundance of evidence to demonstrate that outcome is strongly correlated to the radiation doses delivered and that treatments may be planned accordingly. This is particularly true for radioiodine treatment of benign and malignant thyroid disease, I-131 mIBG for neuroblastoma and Ra-223 for bone metastases. This leads to the potential to adopt a new approach to the administration of radiotherapeutics for cancer, based on predicted outcomes rather than either the activity administered or radiation does delivered as independent parameters.

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