

Therapeutic radiolanthanides and the dosimetry by using PET

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Various radiolanthanides are routinely applied for therapeutic purposes. Recent successful endoradiotherapy (ERT) treatments with ^{90}Y - or ^{177}Lu -labelled peptides and antibodies have renewed a strong interest in the potential of particle emitting radiolanthanides. The potential of radiolanthanides lies in the spectrum they provide of low ranges of β^- particles in tissue, but also in the different types of emitted high linear energy transfer (LET) particles (Auger electrons, and in some cases α -particles) in addition to the low LET β^- particles. Fortunately, these trivalent lanthanides possess similar co-ordination chemistry and may therefore be introduced to relevant compounds via sophisticated bifunctional chelators, already established e.g. for the analogue 4d-radioisotope ^{90}Y . Typical preparations of those radiolanthanides therapeutic applications such as radiosynovectomy, palliative treatment of bone metastases, and for therapeutic strategies using labelled peptides or antibodies are illustrated [1,2].

Potential radiolanthanides are basically characterised in terms of types of decay, modes of production and specific activities. This set of radioactive lanthanides provides a variety of nuclear parameters such as half-lives, types and energy of emitted particles, yet with chemical similarities. The approach of using one and the same targeting vector labelled with selected individual radioisotopes of a number of 4f-elements may provide an optimum choice of therapeutic strategies.

With the increasing availability and application of therapeutic tracers, other new considerations are becoming relevant, namely to increase specific activities and to optimize radiation doses. In particular, there is a demand to increase the specific radioactivity of reactor- or cyclotron produced radiolanthanides. Szilard-Chalmers-like approaches have been recently used to achieve high enrichment factors.

Concerning radiation doses, dosimetric aspects have been calculated utilizing nuclear decay parameters in terms of radiation dose and range, resulting in tumour-to-normal-tissue mean absorbed dose ratios. For 28 radiolanthanides, tumour-to-normal-tissue mean absorbed dose ratios (TNDs) were calculated for different tumour sizes, and compared with TNDs for ^{177}Lu , ^{90}Y and ^{131}I recently [3]. Accordingly, ^{161}Tb may be useful as a complement to ^{177}Lu due to its good TND profile. If a high electron energy emitting nuclide is required for therapy, ^{142}Pr , ^{145}Pr , ^{165}Dy or ^{166}Ho may be used instead of ^{90}Y . Thus, from a do-

simetric point of view, several radiolanthanides seem to be more suitable for tumour therapy than the radionuclides used routinely today, such as e.g. ^{169}Er , ^{161}Tb , ^{177}Lu , ^{175}Yb and ^{161}Ho , the latter being most suitable for very small tumours (<0.1 mm).

In addition, pre-therapeutic determination of patient-specific organ doses is very important, but difficult to obtain. Recent developments on positron emitting analogues of trivalent radiometals, such as e.g. ^{86}Y or radionuclide generator-based ^{68}Ga [4] and ^{44}Sc seem to offer modern approaches to use quantitative PET/CT measurements for optimization of therapeutic protocols.

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