Radioimmunotherapy dosimetry studies performed by Monte Carlo simulation

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Introduction

Radioimmunotherapy (RIT) is increasingly being used in the treatment of a variety of malignancies. The conjugation of antibodies with therapeutical radionuclide allows to increase their initial effect. The main advantage of RIT resides in the local irradiation of cells in the range of the emitted particles that can kill neighboring cells with poor antigen expression or non-accessible to antibody. With ever-increasing awareness of radiation effects, radiation dosimetry is becoming more important. The absorbed radiation dose from internally deposited radionuclides is a major factor in assessing risk and therapeutic utility when evaluating new radiopharmaceuticals for use in nuclear medicine diagnosis or treatment.

Materials and methods

The objective of this work was to perform dosimetry in preclinical studies on the use of a radiopharmaceutical based on tetraspanin proteins family. Radiolabeled Ts29.2, developed by the UMR-S1004, has been tested to treat colorectal cancers. The assessment of the absorbed dose from internal deposited radionuclides has been obtained through the methodology developed by the Committee on Medical Internal Radiation Dose (MIRD). According to this method, absorbed dose is estimated from the localized uptake and retention of administered radiopharmaceuticals, the radiation decay data of the radionuclide and simulations of radiation transport. The antibody Ts29.2DOTA was radiolabeled with ^{111}In to determine biodistribution by organ sampling. The cumulated activity for [^{177}Lu]-Ts29.2 and [^{90}Y]-Ts29.2 were extrapolated from [^{111}In]-Ts29.2 bio-distribution as the DOTA moiety chelates both radionuclides. S-factors were calculated by Monte Carlo simulation using GATE simulation code for both ^{177}Lu and ^{90}Y radionuclides.

Results and discussion

A comparison in resulting doses for ^{177}Lu and ^{90}Y shows a calculated dose in tumor 3.5 higher for [^{90}Y]-Ts29.2 compared to the same injected activity for [^{177}Lu]-Ts29.2 due to the higher average energy of beta emitted by ^{90}Y respect to the beta emitted by ^{177}Lu. However the therapeutic index (ratio of absorbed doses for tumor to non-targeted tissues) was very low in [^{177}Lu]-Ts29.2 calculations. ^{177}Lu can be considered has radionuclide to perform RIT.