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Image-based approach for absorbed dose estimation of 64Cu/225Ac-DOTA-trastuzumab using Monte Carlo simulation

Purpose:
Image-based absorbed dose calculation studies have been performed to evaluate the characteristics of theranostic radiopharmaceuticals. The aim of this study was to evaluate the 64Cu and 225Ac-DOTA-trastuzumab absorbed dose in mice using image-based Monte Carlo simulation.

Materials and Methods:
64Cu-DOTA-trastuzumab PET image was acquired at 3 time point at 3, 24, and 48 hour after radiopharmaceuticals injection in mice. Time-integrated activity coefficient in source organs called residence time was calculate in region of interest (ROI) delineable organs. Image-based source organ 64Cu/225Ac S-value were calculate using Geant 4 Monte Carlo simulation. Absorbed dose for 225Ac-DOTA-trastuzumab was calculated by 64Cu-DOTA-trastuzumab residence time and Monte Carlo simulated 225Ac dose map. The relative biological efficiency (RBE) of the alpha particles emitted from 225Ac, was estimated to be 5 (RBE = 5). 225Ac-DOTA-trastuzumab absorbed dose was considered all decay step of 225Ac radioisotopes (221Fr, 217At, 213Bi, 213Po, 209Tl and 209Pb) and summed up after applying weighting factors in the two possible pathways, 2% for 209Tl and 98% for 213Po.

Results:
Residence time of 64Cu-DOTA-trastuzumav in liver was 1.80 MBq-h/MBq that is high uptake region in normal subject. Liver absorbed dose of 64Cu- and 225Ac DOTA-trastuzumab were 2.73E-02 mGy/MBq, 6.37E+00 SvRBE5/MBq. 64Cu-DOTA-trastuzumab absorbed does in lung, kidney, and spleen were 2.97E-03, 3.86E-04, 3.62E-05 mGy/MBq, respectively. 225Ac-DOTA-trastuzumab absorbed does in lung, kidney, and spleen were 3.10E-01, 9.18E-02, 9.12E-03 SvRBE5/MBq, respectively. 225Ac-DOTA-trastuzumab absorbed dose was 2.34E+02 fold higher than 64Cu-DOTA-trastuzumab.

Conclusion:
We performed the 64Cu-DOTA-trastuzumab PET imaging and estimated the image-based internal absorbed dose of 225Ac-DOTA-trastuzumab. This result may help to strategy of treatment for HER2-positive cancer patients using targeted alpha therapy of 225Ac radioisotope.

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Presentation Type

Poster

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