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ORAL PRESENTATION - Production of Four Terbium Radioisotopes for Radiopharmaceutical Applications

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Introduction: Terbium provides 4 radioisotopes, which are suitable for different diagnostic or therapeutic applications in nuclear medicine. These are ^{149}Tb ($T_{1/2}$ 4.1 h, E_{α} 3.97 MeV, I_{α} 16.7 %) for α -radionuclide therapy, ^{152}Tb ($T_{1/2}$ 17.5 h, E_{β} 1.08 MeV, I_{β} 17 %) for PET, ^{155}Tb ($T_{1/2}$ 5.3 d, E_{γ} 86.6/105 keV) for SPECT and ^{161}Tb ($T_{1/2}$ 6.9 d, E_{β} 0.154 MeV) for β -radionuclide therapy. ^{161}Tb is similar to the clinically employed radiolanthanide ^{177}Lu , but emits in addition a number of conversion- and Auger-electrons.

Aim: The production of the four radionuclides should be established in a quality, which is suitable for radio-labeling of biomolecules.

Method: Neutron-deficient ^{149}Tb , ^{152}Tb , and ^{155}Tb were produced at ISOLDE(CERN) by spallation reactions using 1.4 GeV protons onto a 50 g/cm² thick tantalum target followed by online mass separation and deposition onto carrier foils.

^{161}Tb was obtained from neutron irradiation of highly enriched ^{160}Gd targets at the high flux reactor of ILL, Grenoble or spallation neutron source SINQ, PSI.

Chemical separation of Tb radioisotopes was accomplished by cation exchange chromatography using the complexing agent α -hydroxyisobutyric acid (α -HIBA).

Results: 6 MBq ^{149}Tb , 18 MBq ^{152}Tb and 9 MBq ^{155}Tb were obtained in ≤ 1 mL 0.15 M α -hydroxyisobutyrate solution.

Up to 10 GBq ^{161}Tb were produced from irradiated ^{160}Gd targets and obtained in 300 μL 0.05 M HCl.

Radiolabeling of a novel DOTA-folate conjugate was performed with > 96 % yield at Tb:DOTA-folate molar ratios 1:59000 (^{149}Tb), 1:5500 (^{152}Tb), 1:700 (^{155}Tb) and 1:17 (^{161}Tb).

Radiolabeling of DOTATATE was performed with > 99 % yield at ^{161}Tb :DOTA-Tyr³-octreotate molar ratios $\geq 1:6$.

Conclusion: Successful production of the Tb-radioisotopes enabled synthesis of radiolabeled DOTA-folate conjugates and their evaluation in an in vivo study.

Test radiolabeling of DOTATATE confirmed the high specific activity of the obtained ^{161}Tb .

Author: Mr DORRER, Holger (Paul Scherrer Institut, Villigen-PSI, Switzerland & University of Bern, Berne, Switzerland)

Co-authors: Prof. TÜRLE, Andreas (Paul Scherrer Institut, Villigen-PSI, Switzerland & University of Bern, Berne, Switzerland); Dr MÜLLER, Cristina (Paul Scherrer Institut, Villigen-PSI, Switzerland); Dr JOHNSTON, Karl (ISOLDE, CERN, Geneva, Switzerland); Dr ZHERNOSEKOV, Konstantin (Isotope Technologies Garching GmbH, Garching, Germany); Dr BÉHÉ, Martin (Paul Scherrer Institut, Villigen-PSI, Switzerland); Prof. SCHIBLI, Roger (Paul Scherrer Institut, Villigen-PSI, Switzerland & Swiss Federal Institut of Technology, Zürich, Switzerland); Dr KÖSTER, Ulli (Institut Laue-Langevin, Grenoble, France)

Presenter: Mr DORRER, Holger (Paul Scherrer Institut, Villigen-PSI, Switzerland & University of Bern, Berne, Switzerland)

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