Contribution ID: **71** Type: **Oral**

Terbium-149 production: a pragmatic view of its preparation for medical application

Terbium-149 has been proposed as an attractive candidate for Targeted Alpha Therapy (TAT) in nuclear medicine [1], due to its favourable physical decay properties (T1/2 = 4.1 h, Eα = 3.97 MeV, 17%; Eβ+ mean = 720 keV, 7%) [2]. While preclinical studies continue to demonstrate its therapeutic potential [3-5], it was also shown that it can be used for positron emission tomography [4]. The absence of daughter nuclides emitting relevant quantities of α-particles, an advantage over other radionuclides envisaged for TAT, make it a promising radionuclide, despite its limited development to date.

Terbium-149 has been produced at CERN-ISOLDE via spallation in a tantalum target induced by high-energy (1.4 GeV) protons, followed by diffusion, effusion and ionization of the spallation products and subsequent on-line mass-separation. The mass 149 isobars have been collected in zinc-coated gold/platinum/tantalum foils and shipped to Paul Scherrer Institute (PSI), where terbium-149 was chemically separated from its isobaric impurities and the collection material. This was optimized over the last decade using cation exchange and extraction chromatography, respectively [4-6]. The quality of the radionuclide produced was assessed by means of radiolabelling experiments (at molar activities up to 50 MBq/nmol with >99% radiochemical purity), together with γ-spectrometry and inductively coupled plasma measurements. Radionuclidic purity was determined to be up to 99.8%.

The collection of mass separated-terbium-149 and the subsequent radiochemical separation process has steadily improved over the years, such that higher activities can be collected and isolated, while the quality of product can ensure more efficient labelling of tumour-targeting small molecules. While only CERN-ISOLDE and TRIUMF-ISAC currently produce this radionuclide with limited available beam time, the interest in the radionuclide remains high. New facilities (IMPACT-TATTOOS and ISOL@MYRRHA, respectively) plan to upscale and produce large activities of interesting radionuclides, including terbium-149, towards medical research and potential clinical application.

References

[1] Allen. Australasian Radiology 1999, 43:480.
[2] Singh & Chen. Nuclear Data Sheets 2022, 185:2
[3] Beyer et al. Radiochim Acta 2002, 90:247.
[4] Müller et al. EJNMMI Radiopharm Chem 2016, 1:5.
[5] Umbricht et al. Sci Rep 2019, 9:17800.
[6] Favaretto et al. Sci Rep 2024, 14: 3284.

Notes

Under the topic “Isotopes in Nuclear Medicine”.

Primary authors: Dr VAN DER MEULEN, Nicholas (PSI); Prof. MUELLER, Cristina (PSI); Prof. KOESTER, Ulli (ILL)

Presenter: Dr VAN DER MEULEN, Nicholas (PSI)