



Auger Emitting [¹⁶¹Tb]Tb-PSMA-617 Radioligand Therapy in mCRPC with Peritoneal Carcinomatosis

Florian Rosar¹ · Arne Blickle¹ · Moritz B. Bastian¹ · Tilman Speicher¹ · Andrea Schaefer-Schuler¹ · Caroline Burgard¹ · Stephan Maus¹ · Samer Ezziddin¹

Received: 15 October 2025 / Revised: 28 October 2025 / Accepted: 5 November 2025 / Published online: 2 December 2025
© The Author(s) 2025

A 72-year-old patient with metastatic castration-resistant prostate cancer (mCRPC, diagnosis of mCRPC 9 years ago, initial diagnosis of prostate cancer 13 years ago) with diffuse peritoneal, multiple lymph node, and soft tissue metastases received prostate-specific membrane antigen (PSMA) targeted radioligand therapy (RLT) with [¹⁶¹Tb]Tb-PSMA-617. The patient had previously undergone multiple lines of therapy, including androgen deprivation therapy (ADT), androgen receptor signaling inhibitors (ARSI) with enzalutamide and abiraterone, taxane-based chemotherapy with docetaxel, and RLT with [¹⁷⁷Lu]Lu-PSMA-617 (17 cycles across 3 series with a cumulative activity of 118.8 GBq). We opted for [¹⁶¹Tb]Tb-PSMA-617 therapy, as the patient, who had initially shown a favorable response to [¹⁷⁷Lu]Lu-PSMA-617 over initial series and 2 rechallenge series, eventually presented re-progression with diffuse peritoneal metastases. The patient was treated with four cycles of [¹⁶¹Tb]Tb-PSMA-617 with a mean administered activity of 5.1 ± 0.3 GBq per cycle (range: 4.7–5.5 GBq), totaling a cumulative administered activity of 20.5 GBq. Following treatment, PSMA PET/CT imaging revealed a remarkable regression of peritoneal, nodal, and soft tissue metastases. The presented figure shows baseline and post therapeutic [⁶⁸Ga]Ga-PSMA-11 PET/CT after 4 cycles of [¹⁶¹Tb]Tb-PSMA-617 RLT. Pre-therapeutic PSMA PET/CT imaging revealed diffuse peritoneal, multiple lymph node, and soft-tissue metastases, whereas post-therapeutic PSMA PET/CT imaging demonstrated marked regression of these lesions (Fig. 1). In line with the imaging findings, the patient demonstrated a biochemical partial remission, with PSA

declining from a baseline of 312 ng/mL to 39 ng/mL, representing an 87.5% decrease. Prior to initiation of [¹⁶¹Tb]Tb-PSMA-617 RLT, the most severe adverse events observed were grade 2 anemia, grade 2 renal impairment, and grade 2 xerostomia, following CTCAE criteria. No worsening or newly appearing adverse events were recorded following [¹⁶¹Tb]Tb-PSMA-617 RLT.

Terbium-161 is an emerging radionuclide that is attracting growing interest for its potential use in RLT [1]. To date, terbium-161 has demonstrated promising results in pre-clinical studies, preliminary clinical investigation, and most recently in a first prospective phase I/II clinical trial [2–4]. The radionuclide terbium-161 exhibits physical decay characteristics closely resembling those of lutetium-177, including comparable β⁻ emission energies (Lutetium-177: 133 keV vs. Terbium-161: 154 keV) and similar half-lives (Lutetium-177: 6.647 days vs. Terbium-161: 6.906 days). A key distinguishing feature of terbium-161 is its emission of a significantly higher number of low-energy conversion electrons and Auger electrons. These electrons possess an ultra-short tissue penetration range, resulting in a relatively high linear energy transfer. This translates into higher local dose deposition by terbium-161 in comparison to lutetium-177 [5].

This property may be especially advantageous in targeting micrometastatic disease, such as that observed in cases of diffuse peritoneal carcinomatosis. To the best of our knowledge, this case represents the first demonstration of the effectiveness of [¹⁶¹Tb]Tb-PSMA-617 in the treatment of peritoneal carcinomatosis. Current literature only encompasses a limited number of studies exploring the potential of [¹⁶¹Tb]Tb-PSMA-617 RLT mandating further explorative studies to substantiate its evidence, e.g. in the setting of peritoneal carcinomatosis. This case encourages the consideration of terbium-161 for use in PSMA RLT, especially in clinical scenarios where control of diffuse or microscopic tumor spread is critical.

✉ Florian Rosar
florian.rosar@uks.eu

¹ Department of Nuclear Medicine, Saarland University – Medical Center, Kirrberger Str. 100, Geb. 50, 66421 Homburg, Germany

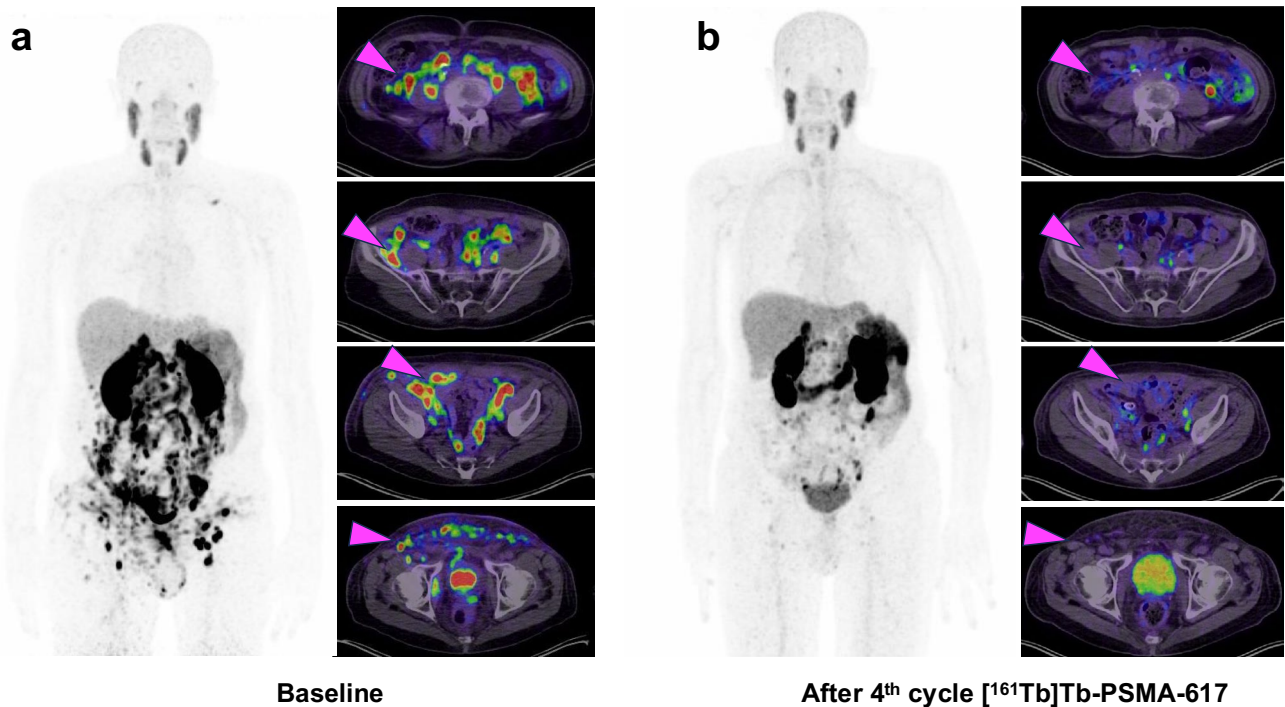


Fig. 1 A 72-year-old mCRPC patient with diffuse peritoneal, multiple lymph node, and soft tissue metastases (exemplary magenta arrows) received PSMA RLT with [^{161}Tb]Tb-PSMA-617. **a**) depicts a [^{68}Ga]

Ga-PSMA-11 PET/CT scan pre PSMA RLT and **b**) depicts a [^{68}Ga] Ga-PSMA-11 PET/CT scan after four cycles of [^{161}Tb]Tb-PSMA-617 RLT with regression of metastases

Authors' Contributions The study was designed by Florian Rosar, Samer Ezziddin. Material preparation and data collection were performed by Florian Rosar, Arne Blickle, Moritz B. Bastian, Tilman Speicher, Andrea Schaefer-Schuler, Caroline Burgard, Stephan Maus, and Samer Ezziddin. The first draft of the manuscript was written by Florian Rosar, Arne Blickle and Moritz B. Bastian, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Tilman Speicher, Andrea Schaefer-Schuler, Caroline Burgard, Stephan Maus, and Samer Ezziddin declare that they have no competing interests.

Funding Open Access funding enabled and organized by Projekt DEAL. There is no source of funding.

Clinical Trial Number NCT04833517, Registry: Prospective REgistry of Targeted Radionuclide Therapy in Patients With mCRPC (REALITY Study), registration date: 2016-01-01.

Data Availability The corresponding data are not publicly available; however, can be provided by the corresponding author upon reasonable request.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Declarations

Ethics Approval and Consent to Participate Ethical approval and consent to participate: The study was approved by the institutional review board of Ärztekammer des Saarlandes, Germany (ethics committee approval number 140/17), and informed consent was obtained from all individual participants included in the study. All procedures performed in studies involving human participants were in accordance with the Helsinki Declaration as revised in 2013 and its later amendments.

References

Consent for Publication The participants signed consent regarding publishing their data (and/or photographs).

Declaration of Generative AI in Scientific Writing Authors did not use generative AI in writing.

Competing interest Florian Rosar, Arne Blickle, Moritz B. Bastian,

1. Müller C, van der Meulen NP, Schibli R. Opportunities and potential challenges of using terbium-161 for targeted radionuclide therapy in clinics. *Eur J Nucl Med Mol Imaging*. 2023;50:3181–4. <https://doi.org/10.1007/s00259-023-06316-y>.
2. Müller C, Umbricht CA, Gracheva N, Tschan VJ, Pellegrini G, Bernhardt P, et al. Terbium-161 for PSMA-targeted radionuclide therapy of prostate cancer. *Eur J Nucl Med Mol Imaging*. 2019;46:1919–30. <https://doi.org/10.1007/s00259-019-04345-0>.

3. Abdulkadir AS, Rosar F, Jalilian A, Moghrabi S, Al-Balooshi B, Rabei O, et al. Harnessing terbium radioisotopes for clinical advancements: a systematic review. *Nucl Med Mol Imaging*. 2025;59:50–61. <https://doi.org/10.1007/s13139-024-00891-0>.
4. Buteau JP, Kostos L, Jackson PA, Xie J, Haskali MB, Alipour R, et al. First-in-human results of terbium-161 [^{161}Tb]Tb-PSMA-I&T dual beta-Auger radioligand therapy in patients with metastatic castration-resistant prostate cancer (VIOLET): a single-centre, single-arm, phase 1/2 study. *Lancet Oncol*. 2025;26:1009–17. [https://doi.org/10.1016/S1470-2045\(25\)00332-8](https://doi.org/10.1016/S1470-2045(25)00332-8).
5. Alcocer-Ávila ME, Ferreira A, Quinto MA, Morgat C, Hindié E, Champion C. Radiation doses from ^{161}Tb and ^{177}Lu in single tumour cells and micrometastases. *EJNMMI Phys*. 2020;7:33. <https://doi.org/10.1186/s40658-020-00301-2>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.