

Lutetium-177 (¹⁷⁷Lu)

Lutetium-177 is a **radioactive isotope** of the element lutetium, widely used in **theranostics** (both therapy and diagnostics).

It emits:

- **Beta particles (β⁻)**: Medium-energy electrons that travel a few millimeters in tissue, causing **localized damage** (useful for targeted therapy).
- **Gamma photons**: Allow imaging with **scintigraphy** (e.g., SPECT scans) to monitor the treatment distribution.

Key Characteristics

Property	Description
Half-life	~6.7 days
Beta energy (Eβmax)	497 keV
Gamma energy	208 keV (11% abundance)
Tissue penetration	0.2 to 2 mm (depending on tissue density)
Production	Produced by irradiating ytterbium-176 targets in nuclear reactors.

Importance in Medicine

¹⁷⁷Lu is crucial for:

- **Targeted radiotherapy**: Attached to ligands that seek out specific cancer cells.
- **Precision therapy**: Short beta range minimizes damage to healthy tissues.
- **Theranostics**: Simultaneous imaging and treatment.

Current clinical uses:

- **Prostate cancer** (¹⁷⁷Lu-PSMA-617 therapy).
- **Neuroendocrine tumors** (¹⁷⁷Lu-DOTATATE therapy).

Emerging research:

- Applications in **glioblastoma**, **breast cancer**, and **renal cancer** where PSMA or similar targets are expressed.

Example: Application in Glioblastoma

- [Comparative evaluation of radiolabeled bombesin analogs \[\(177\)Lu\]Lu-AMBA and \[\(177\)Lu\]Lu-RM2 for targeting GRPR in glioblastoma model](#)
- [Prostate-Specific Membrane Antigen Radioligand Therapy in Non-Prostate Cancers: Where Do We Stand?](#)
- [First clinical experience with fractionated intracavitary radioimmunotherapy using](#)

[\[\(177\)Lu\]Lu-6A10-Fab fragments in patients with glioblastoma: a pilot study](#)

- [PSMA-targeted therapy for non-prostate cancers](#)
- [Short-Interval, Low-Dose \[177 Lu\]Lu-Prostate-Specific Membrane Antigen in the Treatment of Refractory Glioblastoma](#)
- [Novel NK1R-Targeted \(68\)Ga-/\(177\)Lu-Radioconjugates with Potential Application against Glioblastoma Multiforme: Preliminary Exploration of Structure-Activity Relationships](#)
- [Graphene: Insights on Biological, Radiochemical and Ecotoxicological Aspects](#)
- [Theranostics of Metastatic Prostate Cancer Applying ⁶⁴Cu/¹⁸F/⁶⁸Ga PSMA PET-CT and ¹⁷⁷Lu Radiopharmaceuticals](#)

Recent studies suggest [PSMA](#) is expressed not directly on GBM tumor cells, but on **tumor-associated endothelial cells**.

¹⁷⁷Lu-PSMA-617 therapy might:

- **Damage tumor vasculature**, starving the tumor.
- **Bypass blood-brain barrier** defects present in GBM.

Challenges:

- Variable PSMA expression.
- Need for controlled clinical trials.
- Safety concerns regarding radiation to normal brain tissue.

Case Report: A 42-year-old man with refractory GBM showed an **excellent response** to six doses of ¹⁷⁷Lu-PSMA-617 (100-150 mCi every 4-5 weeks), confirmed by MRI and ^{99m}Tc-HYNIC-PSMA-11 scintigraphy ¹⁾

Future directions:

- Larger trials.
- Better [patient selection](#).
- Combination therapies.

A 37-year-old man, treated case of left temporal glioblastoma, presented with headache, seizures, and progressive right-sided weakness with MRI evidence of recurrence. Exploratory Ga-PSMA PET/CT demonstrated PSMA expression in the recurrent lesion; it was decided to treat this patient with Lu-PSMA-617. After 3 cycles of Lu-PSMA-617, Ga-PSMA PET/CT showed significant reduction in PSMA uptake and regression in size of lesion on MRI with improvement in patient's symptoms and performance status. Lu-/Ga-PSMA theranostics has potential in patients with [recurrent glioblastoma](#) when other therapeutic options are not feasible ²⁾.

¹⁾

Ghaedian T, Alipour A, Rakhsha A, Nasrollahi H, Ghaedian M, Andalibi S, Saffarian A. Excellent Response of Glioblastoma Multiforme to [177Lu] Lu-PSMA Therapy. Clin Nucl Med. 2025 Apr 28. doi: 10.1097/RLU.0000000000005904. Epub ahead of print. PMID: 40279656.

²⁾

Kumar A, Ballal S, Yadav MP, ArunRaj ST, Haresh KP, Gupta S, Damle NA, Garg A, Tripathi M, Bal C. 177Lu-/68Ga-PSMA Theranostics in Recurrent Glioblastoma Multiforme: Proof of Concept. Clin Nucl Med. 2020 Dec;45(12):e512-e513. doi: 10.1097/RLU.0000000000003142. PMID: 32558721.

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