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# Case Report of a Clinically Significant Lu-177 Extravasation: Rapid Clearance Kinetics and Dosimetry Using Quantitative SPECT/CT

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## ABSTRACT

Extravasation of Lu-177 radiopharmaceuticals can retain a large fraction of administered activity at the injection site, producing high local doses and reducing delivery to target tumors.

In this case of early extravasation during 200 mCi Lu-177 DOTATATE therapy, the infusion was stopped, IV access re-established, and clearance aided by local hyperthermia with arm elevation. Infiltrated activity was quantified with both a handheld CZT detector and quantitative SPECT/CT, yielding consistent estimates of 62–67 mCi within a 1070 mL soft-tissue volume.

Serial SPECT/CT imaging over 4.57 hours showed rapid clearance (effective half-life 3.66 hours) and a mean self-absorbed dose of 1.035 Gy to the compartment. The two low-dose CT scans contributed an additional 15 mSv effective dose, while the short clearance half-life avoided any change to standard patient release criteria.

This case illustrates a practical clinical workflow for timely extravasation assessment and dosimetry, demonstrating that prompt intervention and rapid biological clearance can limit tissue exposure even after substantial infiltration

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## INTRODUCTION

Extravasation during radiopharmaceutical therapy can retain a substantial fraction of administered activity at the injection site, creating high local absorbed doses and potential tissue injury while reducing delivery to target tumors.

For Lu-177 therapies, timely quantitative assessment of infiltrated activity, clearance, and extravasation dosimetry is essential to support patient-management decisions by quantifying the absorbed dose at the affected site, assessing the risk of tissue damage, supporting documentation, and guiding timely interventions to mitigate harm [1].

## METHODS AND MATERIALS

- A patient receiving Lu-177 DOTATATE (Lutathera; planned activity 200 mCi) was identified with an extravasation early during administration; the infusion was stopped and IV access was re-established per clinical protocol.
- Local hyperthermia and arm elevation were used as mitigation strategies to promote clearance and reduce inflammation.
- Post-administration, infiltrated activity was quantified using (1) a hand-held CZT semiconductor detector (RAVIN CAM, M3D, Ann Arbor, MI) and (2) a xSPECT Quant protocol on a commercial NaI SPECT/CT system (Intevo Bold, Siemens Healthineers, Erlangen, Germany).
- The first SPECT/CT of the arm measured the infiltrated activity and defined the extravasated volume (VOI = 1070 mL).
- A second time-point SPECT/CT (Δt = 4.57 h) was acquired to estimate the effective half-life (Teff) of the extravasated compartment.
- Absorbed dose to the extravasated soft-tissue volume (self-dose only) was calculated with MIRDcalc [2] using a sphere model and the measured Teff.
- Patient-release impact was assessed, comparing the population-based Teff for Lutathera versus the measured clearance.

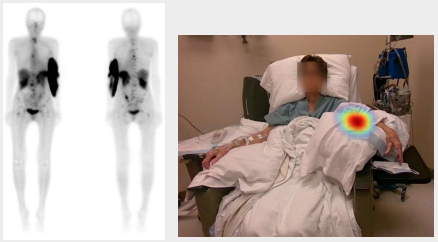

**Figure 2.** Extravasation Identification. Whole body Planar images (left) and RAVIN Cam (Right).

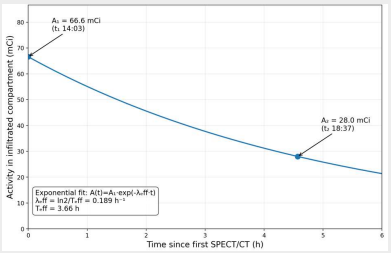


**Figure 3**. Extravasated Activity clearance from quantitative SPECT/CT (two time-points).

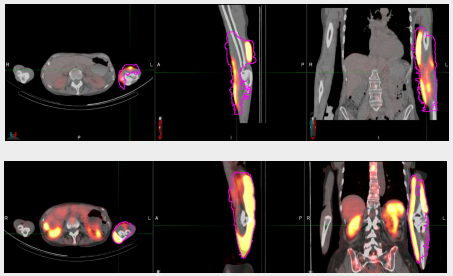

**Figure 4.** Segmentation and quantification of the extravasation using xSPECT/CT. The upper panel shows the subcutaneous distribution of the extravasated activity in the arm at the first time point, while the lower panel shows the whole-body redistribution of activity at the second time point..

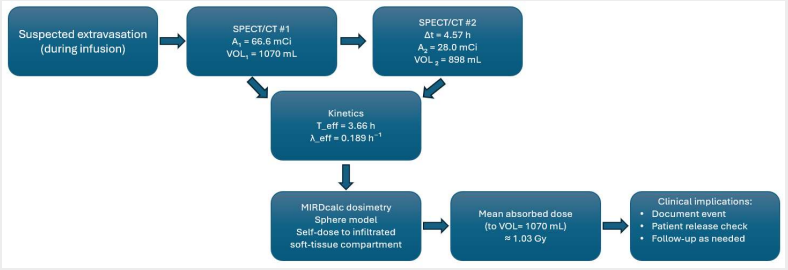


**Figure 1.** SPECT/CT-based extravasation dosimetry workflow

## RESULTS

- Quantitative SPECT/CT estimated 66.6 mCi of infiltrated activity, in close agreement (≈7%) with the handheld M3D CZT detector (61.8 mCi)
- Serial SPECT/CT imaging over 4.57 h demonstrated rapid clearance, with activity decreasing from 66.6 mCi to 28.0 mCi and yielding an effective half-life (Teff) of 3.66 h, consistent with literature values for rapid local clearance (~3–4.25 h) [3,4]
- Patient-specific dosimetry (MIRDcalc sphere model, self-dose) calculated a mean absorbed dose of 1.04 Gy to the 1070 mL extravasated soft-tissue compartment (represents average dose to the defined infiltrated volume).
- Two low-dose CT scans acquired for localization and attenuation correction contributed a total effective dose of 15 mSv (CTDIvol = 5.37 mGy each), as estimated with MIRDct [2].
- The short measured Teff did not increase patient-release restrictions; the site default assumption of 56.1 h remained more conservative than the case-specific clearance kinetics.

## CONCLUSIONS

- This case Demonstrates a practical, clinically feasible workflow for Lu-177 extravasation management using portable detectors and quantitative SPECT/CT.
- Enables rapid identification of extravasation with a handheld CZT detector, followed by accurate activity quantification (~66 mCi in 1070 mL soft-tissue volume).
- Serial SPECT/CT at a second time point allows effective half-life estimation (T_eff = 3.66 h) and patient-specific self-absorbed dose calculation
- Despite infiltration of ~1/3 of the planned activity, rapid clearance limited mean compartment dose to ~1 Gy
- Workflow adds only low CT dose burden while supporting standard patient-release criteria.
- Future work will refine tissue-at-risk dosimetry (skin/subcutaneous layers) and correlate results with clinical outcomes

## REFERENCES

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