EXPERIENCE FEEDBACK

FOCUS ON AN EVENT NOTIFIED TO ASNR

SEPTEMBER 2025

177 LU-PSMA TREATMENT: BENEFITS OF SYSTEMATICALLY DETECTING EXTRAVASATION AFTER INJECTION

Internal Targeted Radiotherapy (ITR) involves the use of radiopharmaceutical drugs (RPD). One of the significant radiation protection events (ESR) reported in 2024 concerned a case of extravasation during treatment with lutetium 177-PSMA (177 Lu-PSMA). Thanks to the centre's organisational measures, the incident was detected quickly and its consequences were limited. With regard to the development of ITR in nuclear medicine departments over recent years, the French Authority for Nuclear Safety and Radiation Protection (ASNR) wishes to share the practices implemented by this establishment and thereby promote a culture of radiation protection.

THE EVENT IN BRIEF

A case of extravasation occurred in a patient during the fifth cycle of ^{177}Lu-PSMA treatment. It was discovered because in this establishment, each of these cycles is systematically monitored by gamma-camera imaging 4 hours after the injection. The patient had not complained of any pain in their arm to the radiographer (RT) who had administered their treatment, but they had felt a tingling sensation. As there was no occlusion at the injection site, the injection pump used to administer the RPD[3] did not trigger an alert. An analysis of the patient's image showed that most of the RPD[3] had spread to the tissues in their arm and forearm. The nuclear medicine physician identified that 45 to 50% of the RPD had spread subcutaneously. The medical physicist (MP) estimated the dose absorbed into the arm to be between 2.8 and 8.8 Gy (the ASNR[2] estimated the dose to be between 5.3 Gy and 9.3 Gy). It was difficult to carry out the dosimetry estimate as it is not possible to accurately assess the diffusion kinetics of RPD[3] based on a single image.

Given the uncertainty of the estimated dose and the appearance of cutaneous erythema approximately 6 hours after the injection, surgical treatment by a plastic surgeon (in accordance with the establishment's internal procedure) was scheduled in order to eliminate as much of the RPD[3] as possible by subcutaneous flushing for 1 hour. The Radiation Protection Adviser (RPA) coordinated the implementation of protection measures, and the dosimetry monitoring of staff. In addition, dose rate measurements were taken on the patient's arm using a RadEye B20 R® detector before and after the procedure. The volume removed was estimated to be around 50% of the extravasated RPD[3]. The following day, new dose rate measurements and SPECT and whole-body planar images showed a very significant reduction in activity in the patient's arm, as well as a typical physiological distribution of the remaining RPD[3] activity.

ANALYSIS OF CAUSES AND INFLUENCING FACTORS

Extravasation is a medical hazard that can be intrinsic to the patient but which nevertheless requires research into the underlying causes in order for it to be confirmed. In this particular case, no technical or human factors were identified that could have explained this incident. However, the fact that the nuclear medicine department did not use a tool to assess the patient's vascular capital is an organisational factor identified as having contributed to the occurrence of the incident.

BARRIERS PUT IN PLACE BY THE ESTABLISHMENT

The barriers put in place by the establishment include:

- each patient undergoes gamma camera imaging to check that the RPD has bound itself to the cancerous lesions and that no extravasation has occurred before the patient is released;
- development, within the quality documentation system, of a protocol specifying the actions to be taken when 177Lu-PSMA treatment is administered, and of procedures to be followed in the event of extravasation of highly radiotoxic RPDs;
- training of staff in these procedures.

ASNR · ANPPH · CNPMEM · Conseil professionnel de la radiologie française · SFMN · sfpm · SOFRA · Avec la participation de l'ANSM

POINTS AND PROCESSES THAT HAVE WORKED WELL

1. Organisational solutions to limit the consequences of extravasation;

- Production of a systematic control image under gamma camera;
- On-site presence of a MP[1], equipped with the tools required to carry out a rapid initial dosimetry estimate, and contacting of the ASNR[2] to request a second dosimetry estimate based on additional data;
- Rapid request for advice from a plastic surgeon available at the time of the event and accustomed to managing extravasations;
- Consultation with a surgeon at Percy Hospital, followed by a multidisciplinary decision to carry out a subcutaneous flushing procedure, given the uncertainty of the dose and the appearance of cutaneous erythema indicating a likelihood of radiodermatitis;
- Coordination between the various professionals, all present on site (RPA[1], MP[1], nuclear doctor, RT[1], plastic surgeon).

2. Technical solutions

- Choice of surgical technique for subcutaneous flushing;
- Implementation of appropriate dosimetry monitoring measures for staff required to approach the patient (wearing of an active dosimeter and, in addition, a ring dosimeter for the plastic surgeon);
- Protection of the surgical team (waterproof suits under sterile garments, provision of eye protection against splashes for the plastic surgeon) and preparation of the operating theatre (waterproof protection and absorbent fields) to avoid radioactive contamination of the premises during the procedure;
- Identification of the patient's blood samples (with the radiation warning trefoil symbol), and informing of the RPA[1]at the biology laboratory before sending them;
- Recovery of contaminated waste which is then transferred to the radioactive waste room;
- Checking the non-contamination of staff, equipment and the operating theatre after its rehabilitation.

ADDITIONAL ACTIONS PROPOSED BY THE OEF WG

Given the potential severity of extravasation during ITR[3], the ASNR encourages nuclear medicine departments carrying out ITR to share their experiences in order to boost reflection on the measures to be taken to prevent extravasation, and to facilitate its detection and rapid management. The working group on the feedback from significant radiation protection events in medical imaging (OEF WG) recommends:

- having a tool for assessing the patient's vascular capital (VC) such as a "score card" during the pre-treatment consultation and during treatment, or even, where appropriate, an imaging system (ultrasound, portable infrared vein detector, etc.);
- implementing systematic detection by planar imaging for a few minutes as soon as possible and no later than 4 hours after the injection (t+4h). If extravasation is confirmed, carry out *at least* another image test, 3 hours or more after the first test. To help quantify the activity, SPECT/CT examinations are recommended;
- questioning the feasibility of injecting the RPD[3] into an implantable catheter chamber (PAC[4]) if the patient's VC[3] has deteriorated, which requires data from pharmaceutical laboratories demonstrating compatibility between the RPD[3] and the PACs[4] available on the market;
- setting up organisational measures and procedures based on SoFRa recommendations[5] relating to the extravasation of RPD[3], which need to be updated;
- implementing a decision tree, enabling during multidisciplinary consultation meetings, to opt for the most appropriate treatment for the patient[6];
- where appropriate, using a radiation meter for early detection of extravasation could be considered if the measurement geometry of the injected arm and the contralateral arm is strictly identical, and if the thresholds for the presence or absence of extravasation have been defined beforehand. To date, as the data on the thresholds and the measurement uncertainties associated with the use of radiation meters are not known, planar imaging remains the most reliable means of systematically detecting extravasation.

1 MP: nuclear medicine physician, RPA: Radiation Protection Adviser, RT: Radiographer.

2 The ASNR operates a telephone hotline which provides initial recommendations in the event of exposure to radionuclides, and has an internal dose assessment laboratory (LEDI) which can assess the dose delivered to organs by a radionuclide incorporated in the body. In 2020, it also published its first experience feedback report on what to do in the event of extravasation (see p. 17 of issue 44 of the REPÈRES magazine: "Contamination lors d'une injection: comment gérer les risques liés à l'extravasation" [Contamination during an injection: how to manage risks related to extravasation]).

3 ITR: Internal Targeted Radiotherapy, VC: vascular capital, RPD: radiopharmaceutical drug.

4 PAC: Port-à-cath®, a small box placed under the skin and connected to a catheter that is guided (threaded) into a large vein above the right side of the heart called the 'superior vena cava' to avoid damaging peripheral veins.

5 E. Barré, M.-L. Nguyen, D. Bruel, C. Fournel, B. Hosten, S. Lao, L. Vercellino, N. Rizzo-Padoin Extravasation des médicaments radiopharmaceutiques : mesures préventives et prise en charge recommandées par la SoFRa (Société française de radiopharmacie) [Extravasation of radiopharmaceutical drugs: preventive measures and management recommended by the SoFRa (French Society of Radiopharmacy)] - https://doi.org/10.1016/j.pharma.2013.05.001.

6 taking into account the dose calculated at the extravasation site, and the RPD's diffusion kinetics and uncertainty – given that a risk of necrosis has been observed for doses exceeding 20 Gy.