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Topical Device Detection of 18F FDG Dose Leakage

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Abstract

PET and standard uptake value (SUV) depend on reliable pharmacokinetic modelling, part of which is predictable dose delivery. Partial extravasation of the intravenous dose administered undermines predictability of dose delivery and potentially the accuracy of the SUV calculation. Utilisation of the LARA device with topical sensors is a simple, non-invasive way to determine partial dose extravasation. As part of routine monitoring of 18F FDG PET administrations, an interesting case was identified that mimicked extravasation but represented dose leakage during infusion via an auto-injector. The LARA device provided a useful tool for more timely critical evaluation and problem solving; extending advantage to the patient and practice.

Introduction

Positron emission tomography (PET) and quantitative values like the standard uptake value (SUV) depend on reliable pharmacokinetic modelling, part of which is predictable dose delivery. Partial extravasation of the intravenous (IV) dose administration undermines predictability of dose delivery and potentially the accuracy of SUV calculations (*1*). Visually reviewing images post PET procedure is perhaps the most common way to identify extravasation, however, as the injection site may be outside the field of view with wholebody PET performed typically with the arms hyperextended above the head (figure 1), this method is not always accurate (*2*). A simple method for detecting extravasation is the use of the LARA (Lucerno Dynamics, LLC, Morrisville, NC, USA) device that uses topically applied scintillation sensors to monitor activity migration in from the injection site during the uptake phase. Data from the USA using this device suggests as many as 23% of doses are partially extravasated and go undetected (*3*).

Case

A 58 year old male with a history of follicular lymphoma presented for wholebody 18F FDG PET for follow-up evaluation 2 months post chemotherapy. The patient was administered with 331 MBq of 18F FDG via a 20-gauge cannula in the right cubital fossa. As part of standard care, LARA sensors (Lucerno Dynamics, LLC, Morrisville, NC, USA) were applied to the patient using adhesive pads 7cm proximal to the injection site and the same site on the contralateral arm (control arm). The auto injector was connected to the cannula to begin the injection and LARA monitoring continued through the uptake phase as standard protocol. The auto injector was the KARL 100 (Tema Sinergie, Faenza, Italy) which administers the correct dose via a Radinject pump. The information gathered from the LARA device was entered into the software platform and a time activity curve was produced for the injection arm and the control arm (figure 2). Under normal circumstances (figure 3), the injection arm curve is expected to peak early, drop very rapidly to approximately the level of the control arm as the bolus moves away from the point of injection. In this case (figure 2), the injection arm activity peaked, reduced rapidly but remained significantly higher than and did not converge with, the control arm. This finding is consistent with retention of the 18F FDG at the injection site. The patient was prepared for scanning and wholebody imaging was performed (figure 4). On examination of the time activity curve (figure 2), closer attention was paid to the wholebody PET scan which was noted to be of low count and poor quality (figure 4) and

with skin contamination with 18F FDG (figure 5, arrows). Further investigation revealed a large portion of the intended 18F FDG dose was resident in the pillow on which the patients arm rested during the injection and uptake phase. In this case, the dose was not extravasated but a leaking connector saw part of the dose reach the patient's systemic circulation and the remainder of the dose shunted outside the injection apparatus and absorbed into the pillow (with some skin contamination on the arm and flank). The patient was rescheduled and subsequent 18F FDG PET scan was performed without incident (figure 6).

Conclusion

While the auto-injector set-up with a large bore cannula and high volume flush is thought to minimise partially extravasated doses compared to hand injection, in this case, hand injection would have provided the opportunity to have observed the leak with corrective measures circumventing the majority of the leakage and need for repeating the study. Auto-injectors also reduce staff radiation dose so the added value needs to be offset with measures to ensure unsupervised injection lines remain patent. The LARA device provided a useful tool for more timely critical evaluation and problem solving; extending advantage to the patient and practice.

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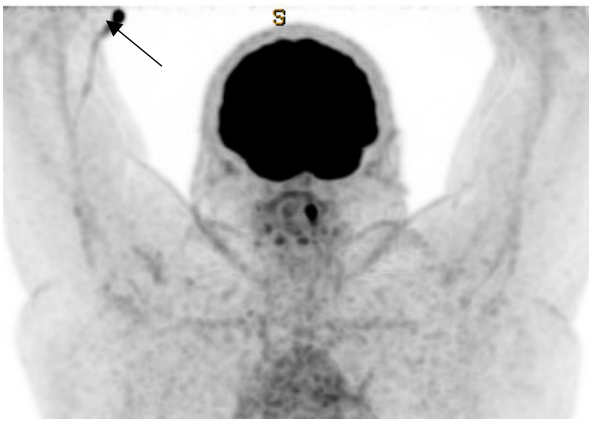

Figure 1: Partial extravasation (arrow) of 18F FDG in a patient in whom the reconstructed study excluded the injection site from the field of view.

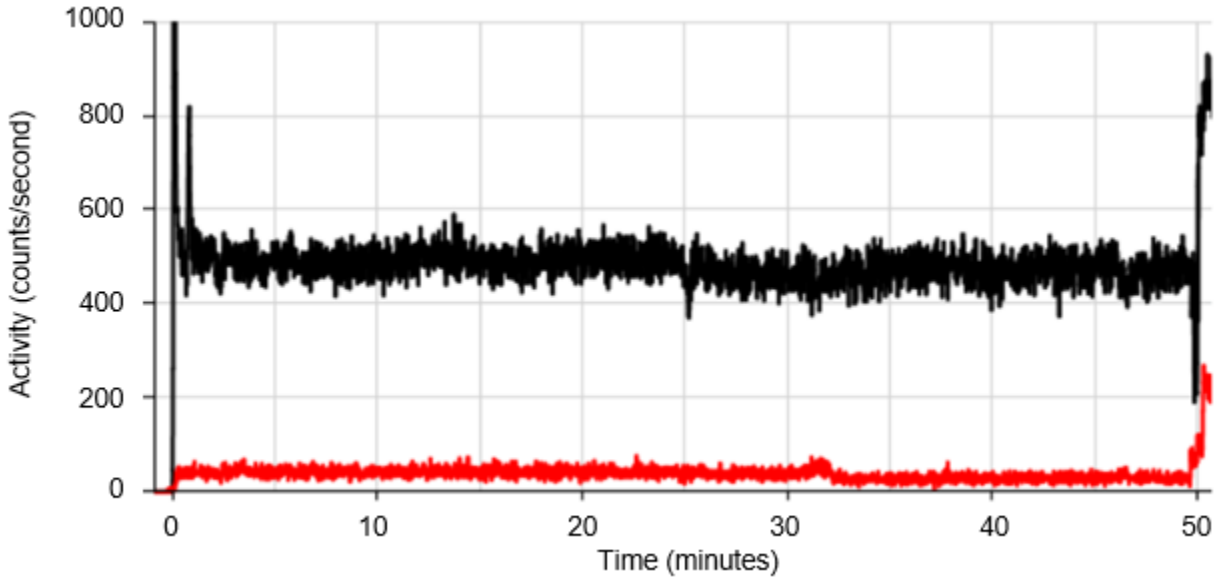

Figure 2: Time activity curve for the injection site (black) and the control arm (red) demonstrating rapid peak of the injection bolus followed by static residual activity in the injection arm suggestive of extravasation.

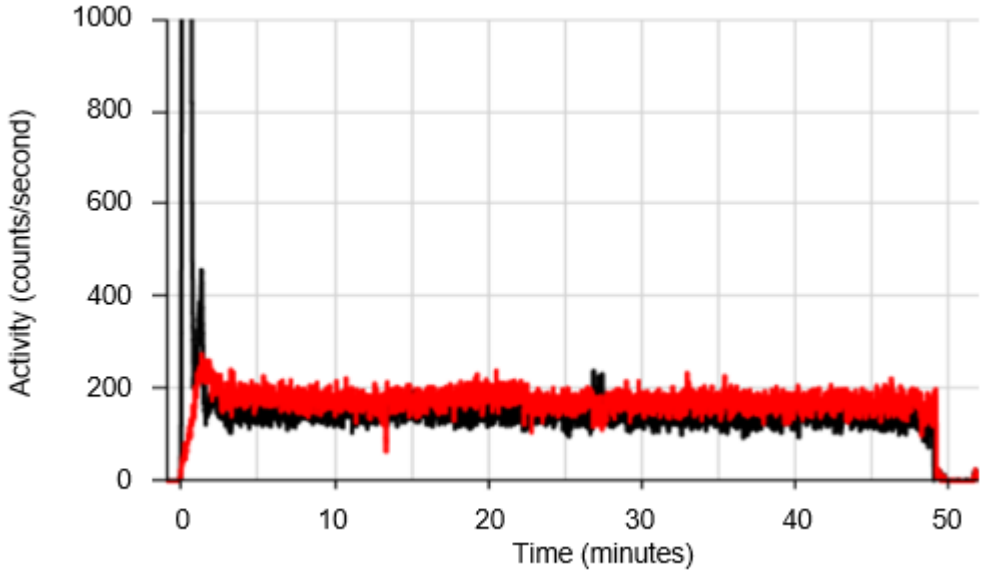

Figure 3: Time activity curve for the injection site (black) and the control arm (red) demonstrating rapid peak of the injection bolus followed by normalisation to the control arm suggestive of a clean injection (no extravasation).

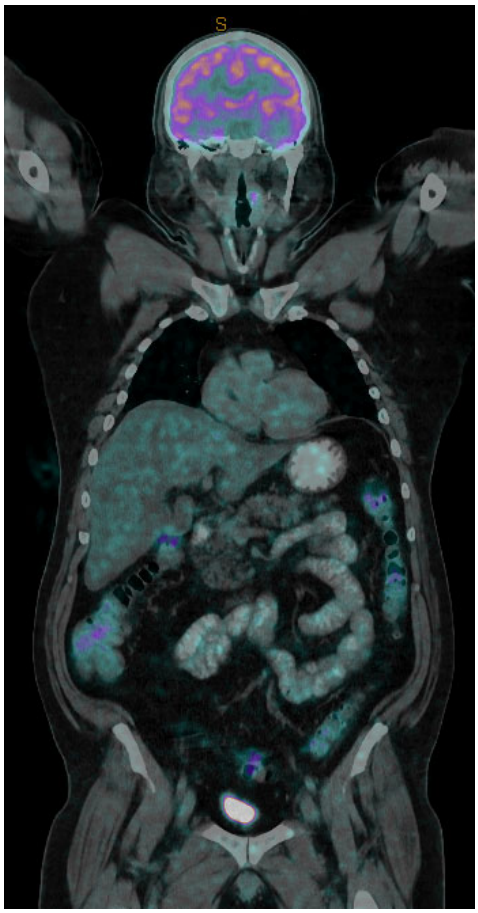

Figure 4: Wholebody (truncated at hips) 18F FDG PET/CT at 60 minutes post intravenous administration.

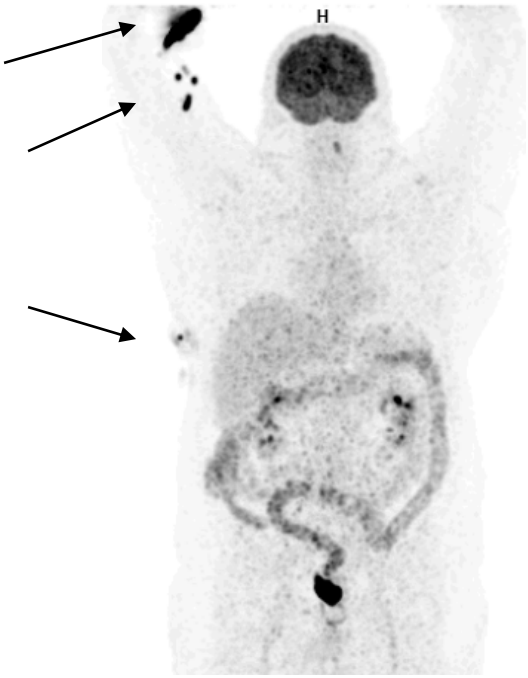

Figure 5: Wholebody (truncated at hips) 18F FDG PET at 60 minutes post intravenous administration with demonstrated skin contamination of the radiopharmaceutical (arrows).

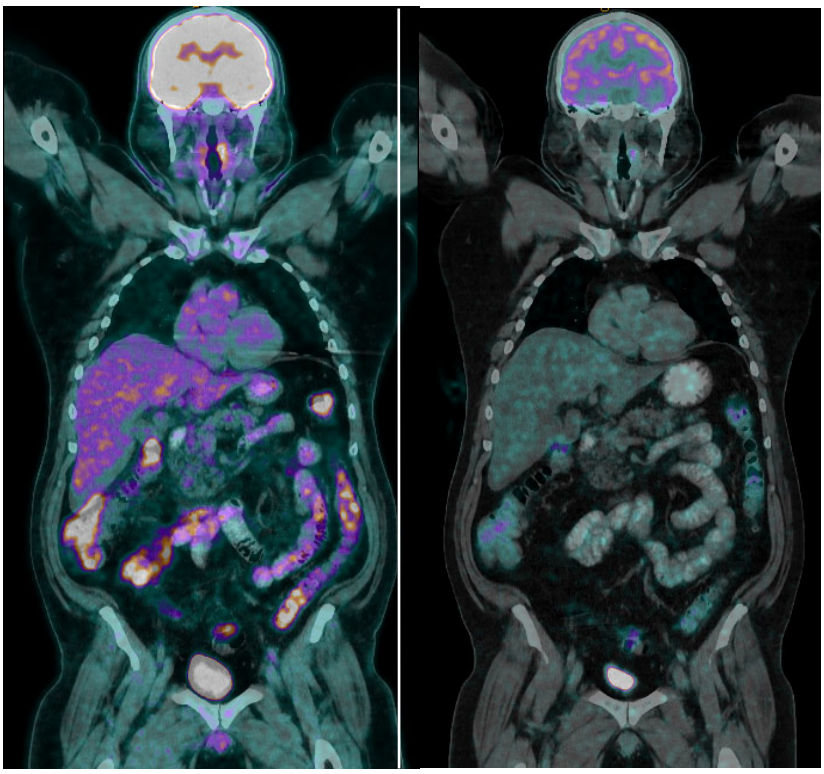

Figure 6: The repeated 18F FDG PET/CT (left) demonstrating superior counts and quality compared to the original (right) suffering count loss associated with leaked activity.