RADIOCHEMICAL STABILITY OF [^{68}Ga]Ga-PSMA IN INJECTION SYRINGES: EVALUATION FOR SAFE DOSE REASSIGNMENT

3PC-040

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BACKGROUND

[^{68}Ga]Ga-PSMA = Prostate Specific Membrane Antigen labelled with gallium-68 (^{68}Ga)[1]

This extemporaneously prepared hospital radiopharmaceutical contains a radionuclide with time-dependent decay and is administered intravenously for prostate cancer diagnosis[2,3].

Preparation and administration involve polymer-based syringes (polypropylene, polyisoprene), sometimes containing a silicone rubber and lubricant[4], as well as metallic needles.

These materials may induce container–content interactions (absorption, adsoption, leachable release…) that can alter pH and compromise radiopharmaceutical stability[5,6]. In addition, trace metals, particularly iron (Fe^{2+}, Fe^{3+}), may interfere with ^{68}Ga radiolabeling efficiency[6,7].

The stability of [^{68}Ga]Ga-PSMA in contact with these materials has not been, to our knowledge, investigated, and the impact on dose reassignment remains unclear.

PURPOSE

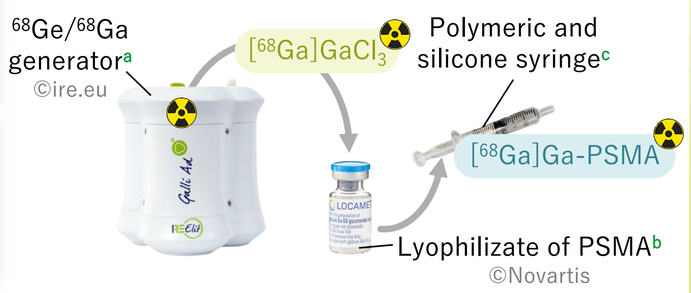
In nuclear medicine and radiopharmacy settings, dose reassignment may require temporary storage of prefilled syringes. However, data on the medium-term physicochemical stability of the [^{68}Ga]Ga-PSMA solution in syringes are limited.

We aim to determine the **maximally acceptable storage period in contact with these materials that allow a safe reassignment** ; provided that the radioactive activity is sufficient.

MATERIALS & METHODS

STEP 1

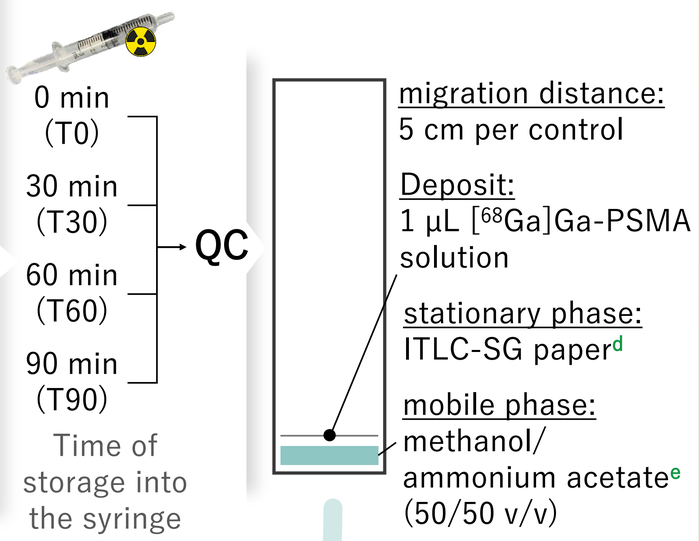
Fig 1 : Synthesis of [^{68}Ga]Ga-PSMA and syringe filling



a. Galli Ad®, IRE-Elit®, Fleurus, Belgium
b. LOCAMETZ® 25 µg, Novartis®, Bâle, Switzerland
c. Syringe **SY3-3SC-EC**, NIPRO®, Osaka, Japan

STEP 2

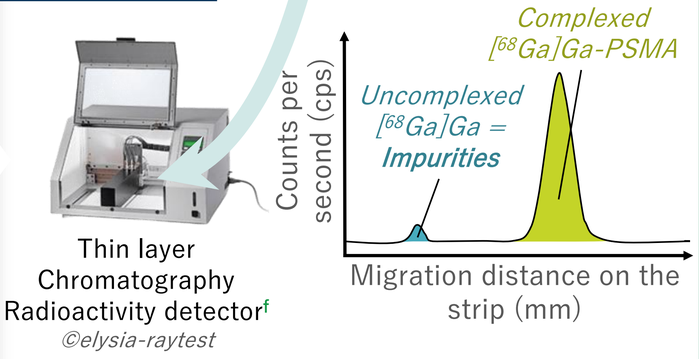
Fig 2 : Storage of the fill syringe and quality control (QC) by thin-layer chromatography



d. ITLC-SG paper, Agilent®, Santa-Clara, United-States
e. Carlo-Erba®, Val-de-Reuil; France

STEP 3

Fig 3 : Radiochemical purity (RCP) determination



f. Elysia-Raytest®, Straubenhardt; Germany

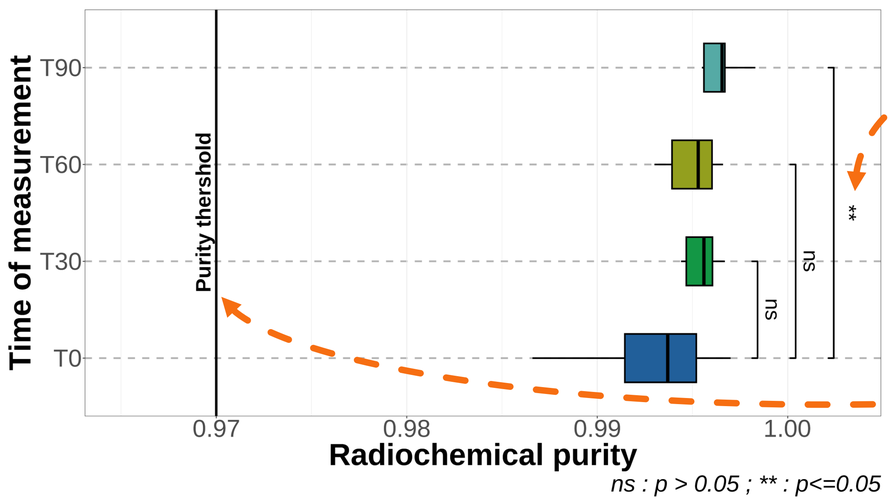
$$\mathbf{RCP} = \frac{\mathbf{Complexed\ [^{68}Ga]Ga\ area}}{\mathbf{Total\ [^{68}Ga]Ga\ area}}$$

$\mathbf{RCP} \geq \mathbf{97\%}$ (PSMA's solution purity threshold allowing injection)

RESULTS

Fig 4: Graphical representation of the average radiochemical purity (RCP) obtained at each measurement time (T0, T30, T60, and T90).

Comparison of the average RCP obtained after 30, 60, and 90 minutes of storage in the syringe with the mean RCP before storage in the syringe (T0).
A nonparametric Wilcoxon test for paired data with a threshold of α = 5% was used, n = 10.



Only the mean RCP after 90 minutes of storage in the syringe is significantly different from the mean RCP before storage.

All RCP averages are above the purity threshold that allows injection into a patient. The threshold is set at a minimum purity of 97% by the manufacturer.

Tab 1 : RCP variation coefficient for each [^{68}Ga]Ga-PSMA synthesis

Evaluation of RCP variability between each synthesis based on the coefficient of variation of the PRC over time (T0, T30, T60 and T90). Comparison of the coefficient of variation with the EANM acceptability threshold of 5%[8].

No coefficient of variation exceeds the 5% variability threshold accepted by the EANM[8].

n° of the [^{68}Ga]Ga-PSMA synthesis (n=10)	RCP mean ± standard deviation (n = 4)	Coefficient of variation (%)
1	0.995 ± 0.002	0.198
2	0.996 ± 0.001	0.144
3	0.993 ± 0.003	0.328
4	0.996 ± 0.001	0.089
5	0.994 ± 0.002	0.212
6	0.994 ± 0.002	0.182
7	0.996 ± 0.002	0.190
8	0.991 ± 0.004	0.403
9	0.995 ± 0.003	0.258
10	0.996 ± 0.001	0.078
Total	0.995 ± 0.002	0.251

CONCLUSION & DISCUSSION

The results show that the [^{68}Ga]Ga-PSMA solution remains compliant with the specifications[9,10] throughout the entire analysis period of its RCP. No alteration of the radiopharmaceutical was observed, nor any harmful container–content interaction detected.

The improvement in RCP at T90 may result from radiochromatograph saturation at T0 (due to high radiopharmaceutical activity), attenuating the complexed [^{68}Ga]Ga peak, or from the radioactivity decay reducing the impurity peak within the device's limits. In both cases, the peaks area ratio increases over time, improving the RCP until it becomes significantly different.

Overall, sufficient residual activity ensures physicochemical stability, allowing safe delayed clinical use.

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