Purification of ^{68}Ga from ^{68}Ge/^{68}Ga radionuclide generator combining two different columns

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Introduction: The ^{68}Ge/^{68}Ga radionuclide generator provides an excellent source of positron emitting ^{68}Ga for the routine synthesis and application of ^{68}Ga-labelled compounds using PET. However, newly available "ionic" ^{68}Ge/^{68}Ga radionuclide generators are not necessarily optimized for the routine synthesis of ^{68}Ga-labelled radiopharmaceuticals in a clinical environment. The eluates have rather large volumes (up to 10 ml for a complete elution), a high concentration of H^+ (pH 1), a breakthrough of ^{68}Ge of 10^{-2}%, increasing with time or usage frequency, and impurities such as stable Zn(II) generated by the decay of ^{68}Ga, Ti(IV) a constituent of the ^{68}Ge adsorption column material and Fe(III) as a general impurity.
Recently, we have introduced a post-processing approach to absorb ^{68}Ga online from generator eluates on a small cation exchange resin (a) to purify it using HCl/acetone mixture N1 (b) and to desorb ^{68}Ga from the resin quantitatively using 0.4 ml of an 0.005M HCl/acetone (98.5%) solution N2 (c). The overall content of acetone in the purified ^{68}Ga fraction is small and non-toxic [1]. However, for some reasons it may be reasonable to reduce this amount of acetone further.

Experimental: The first step of concentration and purification of the initial ^{68}Ge/Ga generator eluate was performed utilizing a miniaturized column with an organic cation exchanger resin (AG 50W-X8, 200-400 mesh) and HCl/acetone media. The ^{68}Ga eluted with 7 ml of 0.1N HCl was transferred within 1-2 min onto the chromatographic column. This represents the basic step to recover radiogallium from the generator eluate and to remove the main parts of the chemical and radiochemical impurities. In the next step, the column was eluted with 1 ml of a solution of 80% acetone and 0.15N HCl (N1). For recovery, the cation exchange column was washed with various volumes of HCl solutions of different concentration and finally with water. The ^{68}Ga fraction is than online transferred to a small (50 mg) column with organic anion exchanger resin (AG 1-X8, 200-400 mesh) or resins based on N,N,N',N'-tetra-n-octyldiglycolamide (TODGA) 50–100 μm particle size.

Results and Discussion: The elution profile of the ^{68}Ga from the anion exchanger AG 1-X8 or TODGA in initial generator eluate shows highest efficacies in the first 100 μl water fraction, i.e. 74±10% in fraction #1, 17±10% in fraction #2, and 6±1% in fraction #3. Altogether, about 96% of ^{68}Ga are being successively desorbed in only 300μl of water.

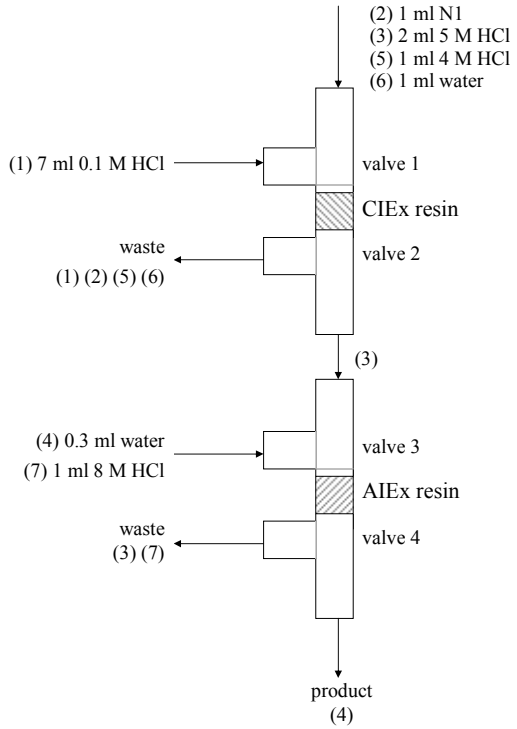

Figure 1. Sketch of a ^{68}Ge/^{68}Ga generator elution with cation and anion exchange columns in tandem (arrows indicate the flow directions)

All ^{68}Ga elutes from the cation exchange cartridge and quantitatively stays on the anion exchange resin. Afterwards, 84±5% ^{68}Ga was eluted from the anion exchanger with 0.3 ml of H_2O as described in literature [2,3]. The complete process takes only about 5 min. The high purification factor concerning ^{68}Ge and other metallic impurities is still preserved due to the initial cation exchange resin. With only 10±5 Bq of ^{68}Ge detected in the final 0.3 ml water fraction, the overall breakthrough of ^{68}Ge is about 10^{-6}%. The pH of the final product it very acidic, but it can be increased by using 0.3 ml 0.1-0.5M NaOH instead of 0.3ml water as eluent.

References:

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Acknowledgement
This project was supported in part by the EC via the COST action D38.