A Study on the Development of ^{82}Sr/^{82}Rb Generator System

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1. Introduction

Nuclear imaging is the most commonly used means to non-invasively diagnose poorly perfused myocardial region resulting from coronary artery disease [1]. Several radioisotopes are used in myocardial perfusion imaging. The most validated radioisotopes for the measurement of cardiac blood flow are: ^{13}N, ^{15}O, ^{99m}Tc, ^{201}Tl and ^{82}Rb. ^{13}N, ^{15}O and ^{201}Tl require the presence of an on-site cyclotron, whereas, ^{82}Rb and ^{99m}Tc are obtained from generators [2]. Radioisotope generators provide an inexpensive and convenient alternative to on-site cyclotrons for the production of short-lived radioisotopes. Especially, ^{82}Rb as a β^+ emitter allows positron emission tomography (PET) imaging and several reports have shown superior diagnostic performances of ^{82}Rb-PET like image quantification with high resolution and sensitivity as compared to conventional single photon emission computer tomography (SPECT) using ^{99m}Tc [3].

^{82}Sr is used to produce a medical radioisotope ^{82}Rb. The half-life of ^{82}Sr is 25.5 days, which results in a generator life of 6 to 8 weeks [4]. The ^{82}Sr parent is difficult to prepare, because in routine generator production, certain purity is required to meet appropriate specifications of the product. However, our research group reported that Sr of high purity and yield was obtained by an optimized separation and purification procedure including Chelex-100, AG50W-X8, and AG1-X8 ion exchange columns [5]. As a follow-up study, we tested ^{82}Sr purification method to validate an optimized procedure through the reproducibility study. And then an initial study for the development of ^{82}Sr/^{82}Rb generator was also conducted.

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2. Methods and Results

2.1 Final confirmation of ^{82}Sr purification method based on an optimized procedure

In previous study, ^{82}Sr purification method for Korea Multi-purpose Accelerator Complex (KOMAC) was established by comparative study of various methods. A half dozen additional studies were conducted to validate an optimized purification procedure. In all experiments, same stock solution as well as same conditions were used to confirm the reproducibility.

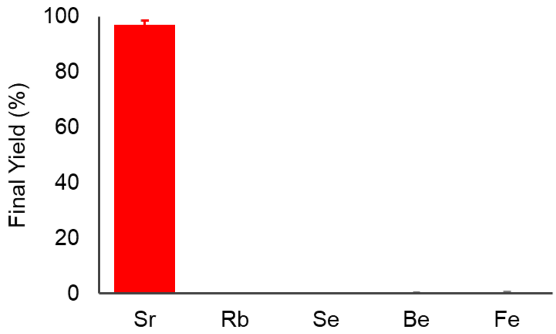

Fig. 1. Results on the final yield of Sr and other impurities purified by an optimized procedure for our facility. (n = 6)

The Sr and other impurities content of the final products are shown as the final yield in Fig. 1. The result shows that not only superior recovery yield of Sr (96.97±1.67%) but also the low concentration of various impurities such as Rb (0.005±0.002%), Se (0.051±0.016%), Be (0.286±0.109%), and Fe (0.472±0.116%) are satisfied to fulfil specification requirements for final Sr product [6].

2.2 Conceptual Design of ^{82}Sr/^{82}Rb generator

Before making a prototype of ^{82}Sr/^{82}Rb generator, we drew a schematic diagram of product. Schematic diagram of ^{82}Sr/^{82}Rb generator is shown in Fig. 2.

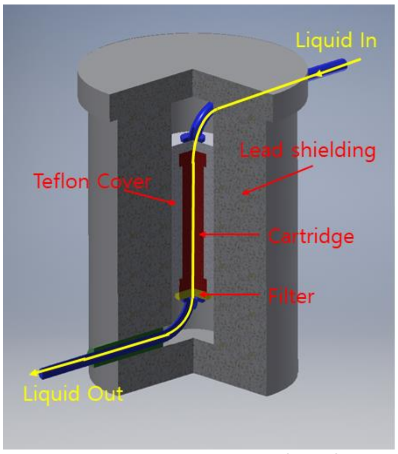

Fig. 2. Schematic diagram of ^{82}Sr/^{82}Rb generator including a thick lead shielding.

^{82}Sr/^{82}Rb radioisotope generator consists of five components such as elution line, column packed with an adequate Sr adsorbent (cartridge), teflon cover for cartridge protection, filter, and lead shielding for blocking scatter radiation.

2.3 Adsorption rates of ^{82}Sr and elution yields of ^{82}Rb

Adsorption rates of ^{82}Sr and elution yields of ^{82}Rb are dependent upon the species of ion exchange absorber, concentration of the eluent, and the flow-rate of the eluent [7]. Two adsorber materials such as Al_2O_3, Chelex-100 were investigated to select an adequate absorbent for use in $^{82}Sr/^{82}Rb$ generator. Comparison result on different adsorbent is presented in Fig. 3.

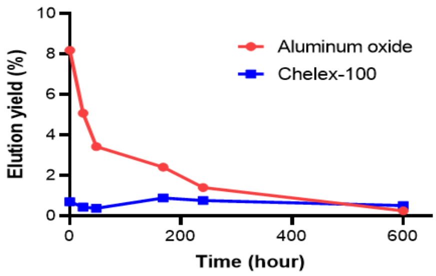

Fig. 3. Elution yields of Sr from Al_2O_3 and Chelex-100 by column elution with eluent.

Adsorption rates of Sr are higher than 90% on both adsorbents (Al_2O_3: 91.8%, Chelex-100: 99.3%). In case of Al_2O_3 adsorbent, the pattern of decreasing Sr loss as a function of time was observed. On the other hand, a loss of around 1% of Sr on Chelex-100 consistently showed. Elution yields of ^{82}Rb are around 90% on both adsorbents (Al_2O_3: 89.9%, Chelex-100: 94.1%).

3. Conclusions

In order to validate an optimized procedure of ^{82}Sr purification, reproducibility and reliability study was carried out. The pure Sr solution (96.97±1.67%) without contaminations like Se, Be, and Fe could be obtained. The KOMAC is trying to apply an optimized purification procedure to radioactive ^{82}Sr for stable radioisotope production. Furthermore, we proposed conceptual design of $^{82}Sr/^{82}Rb$ generator and conducted a preliminary examination on ion exchange absorbents. In future study, we plan to intensely investigate a more various absorbents for selecting the adequate column material.

Acknowledgements

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