

Development of a new type $^{103}\text{Pd}/^{103\text{m}}\text{Rh}$ generator

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$^{103\text{m}}\text{Rh}$ ($T_{1/2}$ 56 min, IT 100%) is an Auger emitter. There are several hundred radionuclides emitting Auger electrons via their decay process. However, it is difficult to fulfill the criteria for ideal targeted radiotherapy by Auger electrons as reported by Bernhart *et al.*¹⁾ Specifically, the radionuclide should have suitable half-life and emit Auger electrons necessary for treatment without unnecessary X or gamma radiation. $^{103\text{m}}\text{Rh}$ is selected as one of the five optimum radionuclides for Auger therapy. The feasible supply of $^{103\text{m}}\text{Rh}$ for clinical application should be achieved by generation because of its short half-life. We recently developed a $^{103}\text{Pd}/^{103\text{m}}\text{Rh}$ generator with comparable performance to those reported previously.²⁾ However, there were several drawbacks, such as low yield, large volume of recovered extractant, and long operation time in conventional type generators. In this study, we developed a new type of generator to address those problems and tested it.

A 100-mg rhodium pellet was irradiated at the AVF cyclotron of the Cyclotron and Radioisotope Center (CYRIC) at Tohoku University or RI beam factory (RIBF) at RIKEN. At CYRIC, the following conditions were used: proton energy of 14 MeV, beam current of 4 μA , irradiation time of 8 hours, at RIBF, deuteron energy of 24 MeV, beam current of 1 μA , and irradiation time of 3.5 hours. Then, the ^{103}Pd without carriers was separated from the Rh-target.²⁾

The new type of generator (approximately 10 MBq) was prepared using nca- ^{103}Pd as follows: 20–30 beads of anion exchange resin (SA11AL: Mitsubishi Chemical) were soaked and shaken in 2–5 mL of 0.1-M HCl solution in which ^{103}Pd was dissolved overnight. The beads were packed into the reservoir (Fig. 1). The prepared generator was filled with 100- μL of 0.1-M HCl solution and left undisturbed overnight. For milking, 500- μL of 0.1-M HCl solution was flushed through the reservoir by a syringe. The measurement of the yield of $^{103\text{m}}\text{Rh}$ and contamination of ^{103}Pd in the $^{103\text{m}}\text{Rh}$ fraction were conducted using a liquid scintillation counter (Tri-Carb 2900TR, PerkinElmer, Waltham, MA, USA) and HPGe-detector (EGC15-185-R Canberra, Meriden, CT, USA) in the same manner as reported previously.³⁾

The contamination of ^{103}Pd in the $^{103\text{m}}\text{Rh}$ frac-

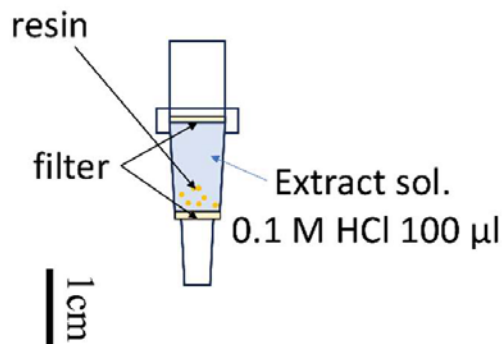


Fig. 1. New-type generator.

tion in the new-type was approximately two times higher than that in the conventional-type; however, the new generator has several advantages compared to the conventional-type. The yield of $^{103\text{m}}\text{Rh}$ in the new-type was $54 \pm 7\%$, which was 1.6 times higher than that of the conventional-type ($33 \pm 3\%$, including the decay for 14-min milking time), and the volume of the fraction was approximately ten times lower (620 μL vs 6 mL), *i.e.*, the concentration of the product fraction was 16 times higher, suggesting an effective in further labelling process. Moreover, the size of the generator was small and easy to handle.

In conclusion, this study demonstrated the feasibility of the new generator. In the future, we will evaluate the long-term availability of this generator system with special emphasis on the radiolysis effect of the packed resin.

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References

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