AN IMPROVED ^{137m}Ba GENERATOR

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^{137m}Ba generators which use ^{137}Cs adsorbed on Dowex-50-type ion exchange resin (*1–3*), on molybdophosphate asbestos (*4*) or on zirconium phosphate (*5*) have been available for some time. The data reported, however, suggested that radiocontamination of ^{137}Cs in the products cannot be neglected after repeated milkings. Moreover, the time-consuming preparation of an injectable solution also resulted in low practical efficiency.

To be of value for medical applications, a nuclide generator should give cleaner and more rapid separation. The present study was designed to evaluate the National Institute of Radiological Sciences (NIRS) ^{137m}Ba generators.

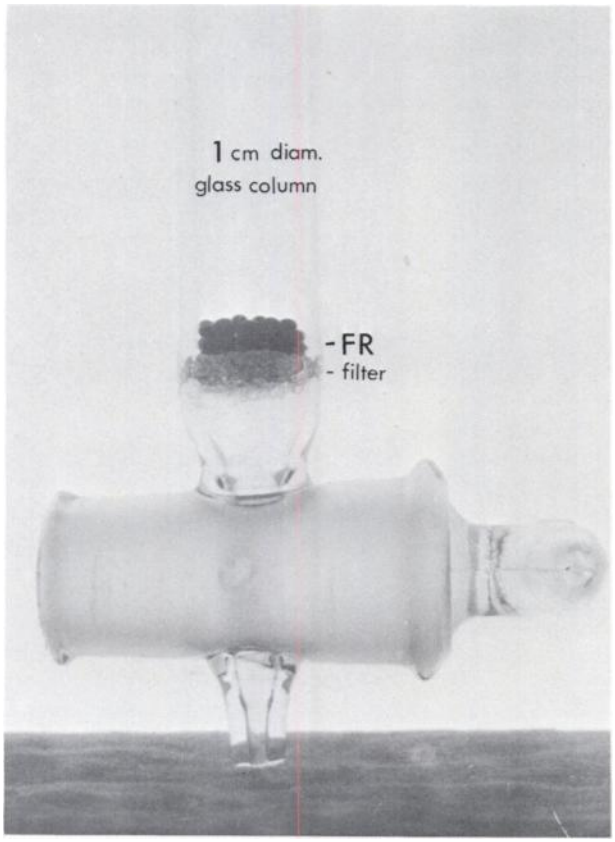

FIG. 1. First ^{137m}Ba generator developed at National Institute of Radiological Sciences in Japan consisted of resin grains in small glass column.

The first generator developed at NIRS consisted of resin grains in a small glass column. Figure 1 shows the simple system.

One hundred milligrams of grains—about 10–20 mesh—of metal ferrocyanide anion exchange resin (Ni-FR, Co-FR, Cu-FR or Fe-FR; Amberlite IRA-904, a macroreticular anion exchange resin containing quaternary amine groups) was shaken with distilled water containing carrier-free ^{137}Cs-chloride for 1 hr and then rinsed with distilled water and dried. With this simple procedure, the metal FR adsorbs nearly 99.9% of the ^{137}Cs radioactivity. Since Amberlite IRA-904 did not adsorb ^{137}Cs by itself, the foregoing effect was obviously caused only by the ferrocyanide portion of metal FR.

The preparation and characteristics of metal FR have been reported in detail elsewhere (*6,7*). To milk the generator, 0.2–2.0 ml of sterilized distilled water or physiological saline solution was charged onto the column. After 30 sec to 1 min, the eluate which contained the carrier-free ^{137m}Ba was collected.

Since the ^{137m}Ba solution that resulted was sterilized distilled water or physiological saline solution with neutral pH, no additional processing was required for it to be used intravenously.

The yield was approximately 45 (10-sec elution with 1 ml) to 60% (5 min elution with 1 ml) of the ^{137m}Ba on metal FR.

The determination of radiocontamination by the parent ^{137}Cs was made by counting the eluate after allowing the ^{137m}Ba to decay away completely and

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by comparing this radioactivity with the original radioactivity at the time of elution. The ^{137}Cs contamination was less than 10^{-6} of the original radioactivity. The contamination decreased in the order Ni-FR < Cu-FR < Co-FR < Fe-FR.

Five hundred milkings or the passage of 2 liters of distilled water dropwise over 48 hr did not increase the contamination level at all. The generators were irradiated with a dose of 10^7 R using a ^{60}Co source to determine radiation-induced decomposition of metal FR; they were autoclaved several times to test their resistance to heating. After these treatments there was no deterioration in their properties.

Figure 2 shows the latest type of ^{137m}Ba generator. The generator consists of a glass column 25 mm in diameter containing 20 gm of multiloaded Ni-FR grains, approximately 50 mesh, held on a coarse fritted glass disk. A piece of filter cloth divides the multiloaded Ni-FR into two layers. The upper layer contains 10 mCi of ^{137}Cs while the under layer has no radioactivity. A retaining cloth screen is placed on top of the Ni-FR and held in place by a tight-fitting Teflon ring. The column is mounted in the interior of a Lucite cylinder.

The preparation of the multiloaded Ni-FR is as follows:

Amberlite IRA-904 (Cl form)
↓ —$K_4Fe(CN)_6$ solution (0.5 *M*)
Ferrocyanide form
↓ —$NiCl_2$ solution (1 *M*)
Nickel ferrocyanide resin
↓ —$K_4Fe(CN)_6$ solution
Ferrocyanide form
↓ —$NiCl_2$ solution
Repeat
↓

In this case the loading was repeated four times. A more detailed procedure will be reported elsewhere.

The ^{137}Cs contamination level in the eluate was far below that in the elute collected from the first system described above, showing less than 10^{-7} of the original radioactivity. The double-layer system has been used over 2 months, and to date no increase in the contamination level has been found. Very long-term storage effects have not yet been investigated, but it seems that the system could be used over a long period of time because the under layer of Ni-FR can adsorb contamination if it occurs.

Thus the NIRS ^{137m}Ba generators offer several advantages over the systems described previously. There is no likelihood of gross contamination of the parent ^{137}Cs by mal-operation in the separation, and the ^{137m}Ba solution collected is suitable for clinical uses without any additional treatment.

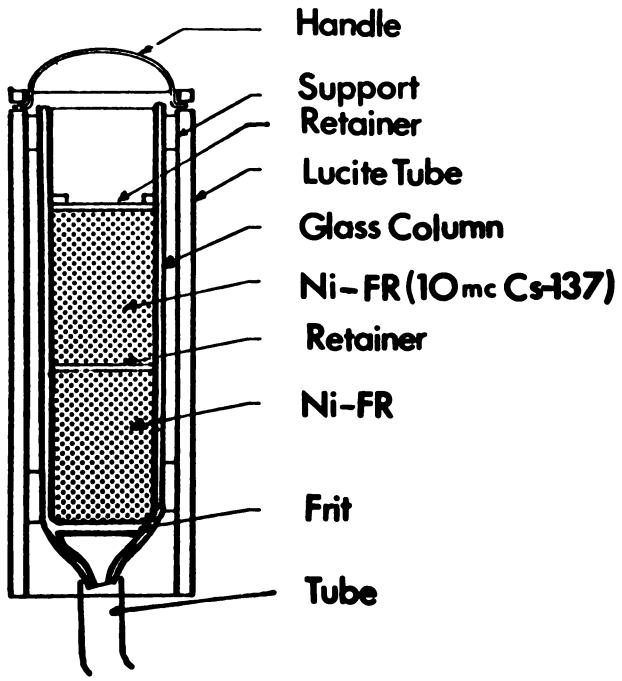

FIG. 2. Latest ^{137m}Ba generator developed contains double layer to insure minimum contamination from ^{137}Cs parent.

Many potential uses of the generators may be expected in rapid dynamic clinical studies, in flow or leak tests in industrial applications and in the classroom for laboratory demonstrations.

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