

LARGE DOSE ERRORS DUE TO REDISTRIBUTION

OF ¹³³Xe IN CARPULES AND PLASTIC SYRINGES

J. Keane, A. Liuzzi, and G. S. Freedman

Yale University School of Medicine, New Haven, Connecticut

The loss of ¹³³Xe because it adheres to certain syringes has been reported (1). Up to 20% of the activity drawn into a plastic disposable syringe for patient injection has been observed by our group to remain in the syringe after injection.

Several of our pulmonary-function studies have given poor results apparently because a low dose was given to the patient. However, the unexpected low dose could not be explained fully by a 20% loss of activity in the plastic disposable syringe used for injection. As will be shown, it now appears that a large amount of the activity is lost to the carpule in which the xenon is delivered. The activity appears to reside specifically in the rubber components of the carpule. Five to 18 days after delivery, approximately 80% of the xenon is found in the rubber components and is unavailable for patient use.

MATERIALS AND METHODS

Xenon-133 dissolved in a saline solution is delivered weekly in a cylindrical glass carpule. The carpule contains a rubber stopper at one end and a metallic tip with a rubber insertion at the other end. The carpule is 2.5 in. long and has a diameter of 5/16 in. The rear rubber stopper is 1/4-in. long and about 5/16 in. in diam. Five, 13, and 18 days after delivery, respectively, the remaining saline solution in three carpules was drawn into 1-cc syringes and

counted. The carpules were then broken and the component parts separated. The rear rubber stoppers, the metallic tips with rubber insertions, and the glass were counted. All counts were made with the Pho/Gamma III scintillation camera; the component parts were placed 8 in. below the collimator and in the center of the crystal field.

RESULTS

The results are tabulated in Table 1. About 80% of the activity present resides in the carpule after the saline is withdrawn. This activity is concentrated in the rubber components of the carpule. About 70% of the total activity is present in the rear rubber stopper and about 10% in the metallic tip with the rubber insertion.

DISCUSSION

If in preparing for a pulmonary-function study one assumed uniform distribution of the ¹³³Xe in the carpule 1 week after delivery and minimal losses due to the adherence of xenon to the carpule, only one-fifth of the calculated dose will in fact be withdrawn. Furthermore, if 20% of the activity is lost

Received Dec. 3, 1970; original accepted Dec. 29, 1970.

For reprints contact: Anthony Liuzzi, Yale University School of Medicine, 60 College St., New Haven, Conn. 06510.

TABLE 1. RELATIVE DISTRIBUTION OF ACTIVITY IN CARPULES CONTAINING ¹³³Xe

Carpule No.	1		2		3	
	5		13		18	
Time after delivery (days)	cpm	%	cpm	%	cpm	%
Activity in carpule with saline	84,700	100	130,653	100	75,672	100
Activity in saline	6,662	7.8	13,480	10.3	7,241	9.5
Activity in empty carpule	65,948	77.8	111,789	85.5	66,512	87.8
Activity presumed lost to atmosphere	12,090	14.4	5,384	4.2	1,918	2.7
Activity in rear rubber stopper	53,995	63.4	—	—	57,933	76.5
Activity of metal tip with rubber insertion	9,505	11.2	—	—	9,620	12.7
Activity of glass	243	0.002	—	—	196	0.002

in a plastic disposable syringe, less than 15% of the dose intended to perform the study will be injected. We believe that this loss of activity has been the cause of several suboptimal studies performed in our department.

CONCLUSIONS

Xenon-133 gas, dissolved in a saline solution, appears to adhere to the rubber components of the carpule in which it is delivered. Little or no activity appeared on the glass components. The results clearly indicate that extracted activity can be underestimated by as much as a factor of five if it is

assumed that the total activity of the carpule is contained in the saline. In light of these results, monitoring extracted saline in its syringe before injection would be advisable. Furthermore, since no activity was observed to adhere to glass, it would also be advisable to use glass syringes. Development of carpules and disposable syringes designed to minimize redistribution of xenon out of the saline is highly desirable.

REFERENCE

1. PONTO RA, KUSH GS, LOKEN MK: Considerations of problems in handling and radiation dosimetry of ^{133}Xe . *J Nucl Med* 11: 352, 1970