Health

700222

Notes on Plutonium Excretion

Discussed at the Health Division Meeting, May 14 and 15, 1945

Discussion led by: E.R.Russell

Tables showing the excretion of product by various animals were presented (MUC-ERR-83). The question was raised as to what value could be set as the daily urinary product excretion from this data. Answer——0.01% of the material retained in the body. The question arose as to why dog 38 (table on page 2) showed a much lower excretion than 0.01%. On the basis that only 65% of the material is absorbed from the muscle and that 20% has been excreted, the 0.01% would also apply to this animal. The data in the tables for all animals, rats, dogs, and rabbits, show from 0.01% to 0.03% daily excretion when constancy is reached.

Dr. Stone——What comparisons have been made as to the concentration of plutonium in the blood and the urinary excretion? Comparisons on 7-and 14-day blood concentrations and urinary excretion indicated little definite information could be gained. Comparing dogs 38 and 39 at 40 days after injection showed that dog 38 had 2.72 ug of plutonium in the circulating blood and during the 24-hour period excreted by way of the urine only 0.125 ug while dog 39 had 0.685 ug of plutonium in the circulating blood and excreted 0.163 ug. This would suggest that dog 38's kidneys are not functioning as well as dog 39's. The unit product concentration in blood and urine for both animals also shows the same discrepancy.

The fecal product excretion for all animals studied has been shown to be from 3 to 4 times higher than the urine collected during corresponding periods. It was suggested that stools be assayed to establish the product content in humans. The difficulties encountered in analysing stools and the comparison of human fecal product excretion to that of dogs would lead one not to rely on this procedure. Dr. Hamilton stated that he is working on a method for stool analyses that should be published very shortly.

The table below was presented to show the value of dog excretion studies to the interpretation of data accummulated on humans. The excretion of Pu for these dogs is compared with that of a single male human having been injected with 6.5 ug of +6 plutonium citrate.

Period	% Excreted-Man % Excreted-Px-33	% Excreted-Man % Excreted-Px-38	% Excreted-Man % Excreted-Px-39
		Urine	
1st 24 hrs	0.4	0.3	0.2
2nd "	1.5	0.44	0.3
3rd "	2.6	0.38	0.6
4th "	5.0	1.1	0.65
5th "	1.1	0.29	0.22
6th "	1.7	0.99	0.47
7th "	0.99	0.63	0.47
8th "	1.0	0.92	0.59
9th "	1.4	1.3	0.79
		Feces	
1st 24 hrs	0.015	0.0068	0.0032
2nd "	0.187	0.063	0.023
3rd "	0.062	0.073	0.053

If we are to place any weight on our animal studies it is quite clear from these results that by far the urinary excretion of dogs and man is more comparable than fecal excretion. Data presented by Mr.Langham on a human tracer experiment using 4.7 ug of the +4 citrate compare very favorably with our results. He also reported low fecal excretion. In his discussion he also pointed out that 50% of the injected plutonium was present in the circulating blood four hours after the injection. Our data showed that at the end of 45 minutes only 15% of the plutonium remained in the circulating blood.

Dr. Stone asked which of the two methods would be suitable for detecting low activities in the urine. Since the IR-1 column procedure was designed to detect approximately 1 γ count per minute in a 100 ml specimen and the tolerance has been set at a level approximately 10 times smaller, the method is certainly not adequate for 0.1 counts. It was suggested that less frequent analyses and larger volumes be used for each specimen. The IR-4 method which has been used for 500 to 1000 ml specimens

has shown considerable variation and is to be investigated further. Specimens from 2 to 3 liters have been assayed by evaporation and precipitation with LaF_3. This is to be avoided if possible because of the long and laborious process.

It was suggested that the plutonium blood concentration be followed more closely and compared with urinary excretion to see if there is any definite relationship. A minimum of two animals must be studied inasmuch as the difference between dogs 38 and 39 was so great.

It was stated that rabbit fecal product excretion is much closer to that of man in the early period than other animals. Data beyond four days after injection for man was not available.

The question of controls was mentioned by Mr. English. The data collected by our group have shown very few controls. The values ranging from 0 to 10^{-5} ug per 500 ml specimens. It was suggested that future work should include a number of control specimens.

In discussing a tolerance limit for plutonium contained in the body the question again arose as to what fraction of a day's urine should be analysed in order to calculate the retained plutonium. Morning specimens have always shown a higher unit activity and any retention calculated from these analysis would be the maximum. For accurate data, the entire 24-hour specimen must be assayed or a large fraction thereof. If the tolerence limit is to be set at 0.7 ug and 0.01% taken as the amount excreted, then 4.8 α counts per day must be detected. It is seen that a minimum of 25% of a 24-hour specimen is to be used for assay purposes. If we are to detect lower activities then the fraction of the daily urine to be assayed should be correspondingly larger. The discussion was concluded with the following suggestions:

1. That larger volumes of urine be assayed for plutonium, preferably portions of 24-hour specimens.
2. That less frequent specimens be collected from the Chicago personnel.
3. That a larger number of control specimens be run.

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Note: The attached table on human excretion is an addition to the excretion tables in MUC-ERR-83.