to possible alterations by an artificial buffer. In veronal buffer yttrium appeared to exist in wholly immobile forms. In plasma buffer, yttrium existed in an immobile fraction and in an unionized fraction which moved with the solvent. Migration of materials as a result of solvent flow must be considered as a factor in the interpretation of electrophoretic studies of this type.

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Effect of 2,3-Dimercaptopropanol (BAL) upon Distribution and Excretion of Plutonium.* (20716)

BERGENE KAWIN† AND D. HAROLD COPP.‡

From the Division of Physiology, University of California Medical School, and the Crocker Radiation Laboratory, University of California, Berkeley, Calif.

Introduction. The transuranic element, plutonium, presents a major health hazard due to its very toxic alpha radiation, long half life, high degree of retention by the skeleton, and extremely slow rate of elimination from the body(1). Although the sulfhydryl compound, 2,3-dimercaptopropanol (BAL) has been shown to have no significant influence on acute poisoning of animals with uranium salts(2) and strontium^{89}(3), it has proven effective in the treatment of systemic metal poisoning with arsenic(4-6), mercury(7), antimony(8), and polonium(9).

Because of the potential importance of plutonium poisoning, the following study was carried out to determine if therapy with BAL might alter the distribution and increase the excretion of this element.

Experimental. Seventeen young adult female Long-Evans rats ranging in weight from 200 to 240 g were each injected intramuscularly with 15 μg of hexavalent Pu^{239} (half-life 2.43 x 10^4 years) as the chloride into the right front leg. The volume injected in each case was 0.25 ml of physiological saline at pH 3. An amount equivalent to the injected dose was made up to volume in a volumetric flask and aliquots were taken to provide standards.

The animals were divided into 3 groups: 1) Controls. These received no treatment. 2) BAL treated. These animals each received 9 injections of 10 mg BAL in 0.1 ml peanut oil in the muscles of the hind leg, at 4-hour intervals following the injection of plutonium. This dose was well below the LD_{50} of 105 mg/kg reported for intramuscular injection in rats(5), and in the range of effective doses used in treatment of mercury and arsenic poisoning(2,5). 3) BAL-pretreated. These rats received a single injection of 10 mg BAL 5 hours prior to administration of plutonium, in order to ensure a high BAL level in the tissues at the time of injection of the metal. They then received the same treatment as the animals in group 2. Each rat was placed in an individual metabolism cage and fed *ad libitum* on the stock ration. Average weight loss was 5-6 g during the experiment. Urine and feces were collected separately at 2 days and 8 days following injection of plutonium. At the end of 8 days, the rats were sacrificed, and liver, kidneys, right femur, right foreleg and left foreleg were removed, dried and ashed at 650°C for 10 hours. The remainder of the animal or "carcass" and the urine and feces were also dried and ashed. The ashed samples

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† Present address: Department of Agricultural Chemistry, Michigan State College, East Lansing, Mich.

‡ Present address: Department of Physiology, University of British Columbia, Vancouver, Canada.

TABLE I. Effects of BAL upon Distribution and Excretion of Intramuscularly Injected Plutonium.

Sample	% of administered dose of plutonium*		
	Controls (7 rats)	BAL-treated (5 rats)	BAL-pretreated (5 rats)
Liver	7.1 ± .8†	8.1 ± 1.3	8.0 ± 1.3
Kidneys	.7 ± .1	.8 ± .1	1.3 ± .6
Femur	1.8 ± .1	1.1 ± .3	1.5 ± .1
Carcass	35.6 ± 3.0	31.8 ± 6.5	27.8 ± 2.5
Unabsorbed in inj. leg	43.5 ± 2.6	48.4 ± 5.9	53.0 ± 5.0
Urine 0-2 day	5.5 ± .8	4.7 ± 1.1	3.6 ± .8
3-8 day	.9 ± .2	.6 ± .1	1.0 ± .2
Feces 0-2 day	1.3 ± .3	.7 ± .3	.7 ± .2
3-8 day	3.6 ± .6	3.8 ± .8	3.1 ± .4

* Values in this table have been adjusted to 100%. The actual recoveries approximated 89 ± 6% of administered doses. Carcass values have been corrected for plutonium present in right front leg bone as separate from amount retained in injected muscles of that leg.

† Stand. error of the mean: $S.E. = \sqrt{\frac{(x-x')^2}{n(n-1)}}$.

were dissolved in N/10 hydrochloric acid, made up to volume, and the plutonium in a suitable aliquot was assayed by the method of Scott *et al.*(10). The alpha radiation was measured with an ionization chamber and linear amplifier.

Results. The results are shown in Table I. The difference between the plutonium in the right (injected) leg and the left leg gave a measure of proportion of the dose which remained unabsorbed at the injection site. In all three groups, almost half of the administered plutonium remained unabsorbed at the injection site even after 8 days. There was no statistically significant difference in the distribution and excretion of plutonium in the treated groups as compared to the controls. This contrasts with the effect on arsenic, mercury and polonium, and may indicate a lack of reactivity of plutonium with the sulfhydryl groups of BAL.

Summary. Intramuscular injection of 2,3-dimercaptopropanol (BAL) in doses therapeutically effective in arsenic and mercury poisoning had no effect on the distribution and excretion of injected plutonium (hexavalent), whether given prior to or following the administration of the metal.

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