Modifying Radionuclide Effects

Studies of radionuclide metabolism and effects have usually involved a single nuclide administered under optimally controlled conditions. People who may be exposed to radionuclides do not, however, live under such ideal conditions and it is important to define and quantitate some of the factors that may influence radionuclide metabolism and toxicity. Potentially important factors that have been identified for study include the effect of pregnancy and lactation, iron deficiency, alcohol ingestion, and protein deficiency.

ALCOHOL AND RADIONUCLIDE METABOLISM

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The effect of ethanol administration on the deposition and retention of polymeric ^{239}Pu and ^{241}Am citrate has been studied in the rat. Only in the case of polymeric Pu was there an effect of alcohol administration.

Excessive use of alcohol can produce a number of physiologic disturbances, including alteration of liver function. Since the liver has an important role in the metabolism of a number of radionuclides, we have investigated the effects of alcohol administration on the metabolism of plutonium and americium.

In the first experiment, rats were fed either 12.5 or 25% ethanol in 25% sucrose solution for 1 or 6 wk. They were then injected intravenously with a suspension of polymeric ^{239}Pu, continued on their respective treatments, and six animals from each treatment group killed either 1 or 41 days later. The percent of the administered dose of ^{239}Pu deposited in liver, lung, and femur are shown in Table 3.38. At 1 day postinjection, the animals given ethanol for 6 wk before Pu injection appeared to have somewhat more ^{239}Pu in the liver than did controls, although the differences had disappeared by 41 days. Lungs of rats given ethanol for 6 wk had lower Pu values than controls. In contrast, animals which received ethanol for only 1 wk prior to Pu administration had an enhanced deposition of Pu at 1 day postinjection compared to controls. These differences were still apparent at 41 days postinjection. There was little effect of treatment on the deposition or retention of Pu in the femur.

The administration of ethanol in 25% sucrose did not result in gross damage to the liver. Two other experiments were therefore performed in which ethanol was administered without sucrose. In the first, 10% ethanol was fed to rats in drinking water for 2 or 8 wk. Americium citrate was then injected intravenously, treatment was continued, and animals were killed at 1, 7, or 28 days to obtain tissues for analysis.

Hepatic deposition of ^{241}Am was greater in females (60%) than in males (49%). In

TABLE 3.38. Distribution of Polymeric ^{239}Pu in Ethanol-Fed Rats

	% of injected Dose					
	Liver		Lung		Femur	
Treatment	1 day	41 days	1 day	41 days	1 day	41 days
Control	33.8 ±4.0(a)	32.8 ±1.0	19.4 ±4.8	13.0 k2.6	0.63 ±0.03	0.94 ±0.11
12.5% Alcohol (6 wk)	50.2 ±6.7	40.0 ±5.5	10.7 ±4.7	5.6 ±2.7	0.53 ±0.4	0.99 ±0.05
25% Alcohol (6 wk)	44.2 ±5.8	35.6 ±4.0	10.5 ±3.7	6.5 ±2.0	0.42 ±0.09	0.90 ±0.11
12.5% Alcohol (1 wk)	32.0 ±2.5	33.5 ±4.6	34.7 ±2.58	17.5 ±1.5	0.38 ±0.01	0.77 ±0.11
25% Alcohol (1 wk)	39.8 k2.8	31.4 24.4	26.3 ±1.4	19.7 ±2.6	0.60 ±0.05	0.77 ±0.11

(a) Standard error

contrast, the uptake of ^{241}Am by the kidney was greater in the male. However, the alcohol treatment did not influence the deposition or subsequent retention by liver, kidney, or any other tissue in either sex.

In the second experiment rats were given an acute dose of ethanol (5 mg/kg body weight) and injected with ^{241}Am citrate 24 hr later. Animals were killed at 1 or 14 days postinjection to provide tissues for analysis. Again, no effect of ethanol treatment on deposition or retention of ^{241}Am was found.

In contrast to these results, Cohen et al. (Progress Report, Institute of Environmental Medicine, NYU, 1977) have recently reported that alcohol increased fecal excretion of Am in the baboon at 90–150 days postinjection.