Exchangeable Magnesium in Hypertension.* (30564)

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Serum magnesium has been found to be reduced in hypertensive patients(1) and some patients with primary aldosteronism have had lower than normal serum magnesium levels (2,3). Aldosterone secretion rates have been shown to be higher in malignant hypertension (4). Aldosterone administration to the normal and adrenalectomized rat accelerates urinary magnesium excretion and causes a fall in muscle magnesium in the adrenalectomized rat(5). As magnesium depletion might therefore be expected in hypertension, a study of the 24-hour exchangeable magnesium in patients with severe hypertension was undertaken.

Materials and methods. Magnesium^{28} (physical half life 21.8 hours) was obtained from Brookhaven National Laboratory with the specific activity of 24-32 mg stable magnesium/540-1180 μc Mg^{28}. Intravenous doses of 70-90 μc were administered to each patient and control subject. Each dose contained 2-3 mg of stable magnesium, pH being between 4 and 5. The stable serum and urine magnesium levels were determined by the method of Simonsen(6). The results given are for the exchangeable magnesium determined from the serum magnesium levels.

Twenty-five patients (17 men and 8 women) with severe hypertension and 17 control subjects (9 men and 8 women) were studied. The ages of the 17 male patients with hypertension ranged from 21 to 65 years. There were 11 Negroes, 2 Mexicans, and 4 Caucasians. The 9 male controls included medical students, technicians and convalescent patients. Their ages ranged from 23 to 58 years. There were 1 Japanese, 1 Negro and 7 Caucasians. The ages of the 8 women patients with hypertension ranged from 31 to 60 years. There were 6 Negroes, 1 Samoan and 1 Caucasian. The 8 women controls were Negro convalescent patients, ranging in age from 18 to 30 years. All hypertensive patients had diastolic blood pressures over 110 mm Hg, and a BUN under 22 mg% at the time of study.

The majority of the patients, after extensive hypertensive work-ups, were considered to have essential hypertension. There were 3, well controlled, male diabetic patients. Most, but not all, of the patients had been off antihypertensive and diuretic therapy for 2-4 weeks.

Results. All of the results are listed in Table I. No striking depletion of magnesium was found, but the following changes were of interest:

Men. No significant difference in the exchangeable magnesium values expressed as total mEq was observed between the hypertensive men and the controls. However, there was a significant decrease in exchangeable magnesium expressed as mEq per kg of body weight in the hypertensive subjects, (3.19 mEq/kg as compared to 3.60 mEq/kg in the controls; $p = .03$). The hypertensive men had a lower serum magnesium level, 1.45 mEq/l as compared to 1.67 mEq/l of the control subjects ($p = .02$).

Women. Total exchangeable magnesium in mEq was significantly higher in the female hypertensives than in the controls (198 mEq and 163 mEq respectively; $p = .04$), but exchangeable magnesium expressed as mEq/kg was not significantly different in the two groups.

Because of the marked obesity of many of the hypertensive women and some of the hypertensive men, the importance of variation in gross body measurement characteristics was considered for all subjects and controls (Table I). The results suggest that normalization of mEq/body weight is the

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TABLE I. Summary Statistics for Comparison of Hypertensive Subjects with Control Subjects.

	Mean		Standard deviation	
	Control	Hypertensive	Control	Hypertensive
Male				
No. subjects	9	17		
Total mEq exchangeable magnesium	264	249	51	33
Weight, kg	73.4	79.3	12.5	13.2
Ideal weight, kg	71.1	69.9	5.9	5.7
Height, inches	68.9	68.7	2.8	3.0
mEq exchangeable magnesium/kg, actual body wt	3.60*	3.19*	.22	.49
mEq exchangeable magnesium/kg, ideal wt	3.69	3.57	.45	.55
mEq exchangeable magnesium/inches height	3.81	3.62	.59	.51
Weight/ideal wt	1.03	1.13	.11	.17
Serum Mg, mEq/l	1.67*	1.45*	.17	.23
Female				
No. subjects	8	8		
Total mEq exchangeable magnesium	163 *	198 *	16	43
Weight, kg	55.5	73.0	4.9	25.0
Ideal weight, kg	58.4	58.1	3.7	3.2
Height, inches	64.0	64.3	2.5	2.1
mEq exchangeable magnesium/kg, actual body wt	2.94	2.86	.20	.72
mEq exchangeable magnesium/kg, ideal wt	2.80*	3.40*	.32	.69
mEq exchangeable magnesium/inches height	2.55*	3.08*	.29	.65
Weight/ideal wt	.96	1.25	.11	.40
Serum Mg, mEq/l	1.52	1.55	.16	.33

* $p = <.05$.

most appropriate of the body measurements considered.

Analysis of the results according to patients' race failed to reveal differences, nor were there differences between the 3 diabetic patients and the remainder of the male hypertensive group. There were no significant differences in results between patients who received diuretics and those who did not.

Discussion. The results indicate reduced exchangeable magnesium (mEq/kg) in hypertensive men, but not in hypertensive women, as compared to the appropriate controls. The reason for the sex difference is not apparent. The reduction in exchangeable magnesium in the male hypertensive is not nearly so striking as that occurring in alcoholic and cirrhotic males(7).

While the normalization by use of mEq/body weight appeared the most appropriate, this measure was not completely satisfactory, particularly in the obese female hypertensive and some other measure of fat free weight or lean body weight might be preferred. The difficulty of obtaining accurate lean body weight without other extensive studies is obvious. Also, there presumably is little magnesium in fat(8).

Change in body magnesium would have to be marked to be detected at 24 hours as exchange is not complete at this period(9,10) and use of longer periods presents problems in accurate measurement, due to decay of radioactivity.

Although diuretics have been shown to cause magnesium loss(11,12) this did not appear to be a factor in the results presented.

Summary. Exchangeable magnesium, expressed per kg of body weight, was decreased in hypertensive men as compared to the controls. The serum magnesium level was also lower in hypertensive men. These changes were not found in hypertensive women. Results in hypertensive women were difficult to interpret accurately, probably because of the obesity of this group.

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Metabolism of 1-C^{14} Octanoic and 1-C^{14} Palmitic Acid by Rat Intestinal Slices.* (30565)

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The classic studies of Bloom and Chaikoff (1,2) and Borgström(3) demonstrated that after intestinal absorption, fatty acid molecules with chain lengths of 10 or less carbon atoms were transported primarily in the portal vein whereas fatty acids with chain lengths of greater than 16 carbon atoms were transported predominantly in lymph. Recent studies(4-7) have indicated that differences in the behavior of fatty acids during absorption are probably due to variations in their intramucosal metabolism as well as to differences in physical properties. However, these studies have dealt primarily with the processes of mucosal hydrolysis of glycerides and mucosal esterification of fatty acids. Little attention has been directed at the problem of catabolism of fatty acids by intestinal mucosa.

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In the present investigation studies were undertaken to define more clearly the differences in the mucosal metabolism of a long chain fatty acid (palmitic) as compared to a medium chain fatty acid (octanoic). The data obtained indicate that octanoic acid is catabolized to CO_2 and water soluble products to a greater extent than palmitic acid by rat jejunal slices. Analysis of the lipid soluble products by thin layer and gas liquid chromatography revealed additional differences in the metabolism of these 2 fatty acids.

Materials and methods. 1-C^{14} octanoic and 1-C^{14} palmitic acid (New England Nuclear Corp.) were purified by thin layer chromatography. The fatty acid substrates were dissolved in a small amount of ether and homogenized in 10% crystalline bovine albumin. Non-radioactive lipid carrier was added before homogenization so that the final concentration of the lipid-albumin suspensions was 10 micromoles lipid per ml.

Aliquots of the various lipid-albumin suspensions and other water soluble products were added to 12 ml of a counting solution prepared as previously described(8). The solution prepared for counting substances in organic solvents contained 15 ml of toluene with 0.04% liquiflor (Pilot Chemical Co.).