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Electrolyte Alterations in Human Plasma and Erythrocytes Associated With Chronic Alcoholism.* (24826)

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Few of the reports in the literature dealing with alcohol intoxication and alcoholism as a medical problem are concerned with its influence on water and electrolyte metabolism. Investigations have been confined to studies of response of normal individuals imbibing alcohol under control conditions, in specific amounts for short periods. Nicholson and Taylor(1) in one of the earliest reports showed that, despite a water diuresis after alcohol administration, Na, K and Cl ions were retained. Only 50% of the retained K could be accounted for in the extracellular fluid of these individuals. Subsequent studies(2,3) have largely complemented the earlier work except that the mode of action of alcohol in production of diuresis has been more accurately delineated(3,4). More recently reports have appeared concerning effects of alcohol on salt and water metabolism in the dog(5,6). Apparently the nature of response to alcohol in this animal is dose-linked. The present report concerns plasma and erythrocyte alterations in 64 human *chronic* alcoholics associated with malnutrition and generalized debilitation.

Methods. The 64 subjects (56 male, 8 female) were chronic alcoholic patients at the Alcoholic Rehabilitation Center. Their ages ranged from 25-67 years with a mean age of 44. All were in poor physical condition with approximately one-half having previous delirium tremens. Most showed signs of poor nutritional background. Ninety % had been drinking heavily for at least 10 years; most had a history of 20 years of alcoholism. While it was difficult to obtain reliable information from the patients, we were reasonably certain that the patients had been continuously drinking from 3 days to 12 months before admission. Beverages consumed consisted of one

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TABLE I. Plasma and Red Blood Cell Electrolyte Values in Normal Medical Students and in Large Group of Chronic Alcoholics.

	Plasma				Erythrocyte			
	Na	K	Cl	Protein,	Na	K	Cl	Hematocrit,
	meq/l			g %	meq/l			%
Normal values								
No. of patients	28	29	27	27	29	29	29	29
Range	138.8–148.8	3.5–5.1	96–126	6.6–7.8	10.3–15.5	93.8–105.0	44–78	43.3–51.0
$\bar{X}$	144.6	4.2	118.8	7.2	12.0	98.6	55.4	47.0
S. D.	± 2.6	± .4	± 8.9	± .3	± 1.2	± 3.7	± 7.7	± 3.9
Chronic alcoholics								
No. of patients	61	61	61	64	62	62	59	60
Range	124.7–151.8	2.5–5.2	76–132	4.9–8.4	9.4–27.8	87.5–108.8	30–74	28.5–50.0
$\bar{X}$	141.8	4.0	102.4	6.8	13.0	101.6	49.4	42.0
S. D.	± 4.2	± .6	± 12.3	± .4	± 3.7	± 4.7	± 8.5	± 4.8
"P"	<.001	<.02	<.001	<.005	<.1	<.005	<.01	<.001

$\bar{X}$ = Arithmetic mean. S. D. = Stand. dev. P = Level of significance.

or some combination of rum, wine, bourbon, gin, beer, vodka, etc. Medical aspects and treatment of this group will be presented later. A 10 ml blood sample was taken on the first day in the Center and before therapy had been administered. This sample was heparinized and centrifuged at 20,000 G in a Servall Super-centrifuge. Plasma and red blood cell Na and K were determined utilizing a Perkin-Elmer Flame Photometer. Chlorides were analyzed chemically by an electrometric modification of the Volhard method(7). Plasma protein was determined by the $CuSO_4$ falling drop method, and hematocrit by the microcapillary technic. Normal values were obtained on 29 normal medical students, and statistical analysis between the 2 groups was made on the basis of unpaired sample data with the "null" hypothesis being rejected at the 5% level.

Results. Experimental results are presented in Table I. Plasma Na, K, Cl and protein concentrations are all significantly reduced in chronic alcoholics as compared to normal medical students. Mean hematocrit value in the alcoholics (42%) is significantly lower ($P<0.001$) than the mean value seen in the controls (47%). Erythrocyte Na remained normal in chronic alcoholic patients, whereas cell K was elevated from a control level of 98.6 to 101.6 meq/l ($P<0.005$) in chronic alcoholics. Red blood cell Cl in alcoholics was reduced an average of 6 meq/l from control values.

Discussion. The long term alcoholic does not usually exhibit the electrolyte alterations which have been reported in cases of acute intoxication(1,2,3,5,6). Nicholson and Taylor (1), utilizing balance studies, showed that retention of K, Na and Cl occurred in short-term observations on medical students given alcohol over an 8 hour period. In contrast, chronic alcoholics, who had been consuming alcoholic beverages excessively for weeks or months prior to study, showed significant reductions in plasma levels of these ions. Patient reports of vomiting over extended periods may account for the hypochloremia seen in these alcoholics. Indeed, the significantly lowered erythrocyte Cl encountered suggests hypochloremia of long duration. Concomitant loss of Na in the vomitus, plus possible compensatory loss of base bicarbonate in the urine, might explain the observed plasma Na reductions. While the reduction in plasma K concentration was statistically significant, very little physiological importance is credited to an average decrease of 0.2 meq/l from control values. However, this study gives little insight into possible alteration in total extracellular K. It is conceivable that in the face of probable reduced extracellular fluid volume (from diuresis and vomiting), some degree of extracellular K depletion occurred which is not readily revealed by observing plasma concentration of this ion. Certainly vomitus can contain a high K concentration

which may result in an inordinate loss of this cation.

It is well known that chronic alcoholism is associated with liver damage. Alcoholic addiction combined with the poor nutritional status of the alcoholic engenders fatty infiltration of the liver with subsequent irreversible hepatic fibrosis. Since the liver is commonly thought to be the site of plasma protein production, and in view of the great probability of serious liver damage in alcoholics, it is not surprising that markedly reduced plasma protein concentrations were encountered in these patients.

The signicant increment in erythrocyte K in the chronic alcoholic agrees with Nicholson and Taylor's conclusion(1) " . . . potassium must be retained in the cells." Their studies, however, were of short duration and involved a relatively limited alcohol consumption, whereas the current experiments involved the long-term, intemperate use of alcohol. Nevertheless, calculations assuming an extracellular fluid volume of 20% of body weight and using average weight of the alcoholic patients (71.6 kg) indicate that an average of 3 meq of extracellular K is lost. Erythrocyte K gain, based on an assumed red blood cell volume of 4% of the body weight, equals 8 meq. From such approximations it is clear that K is either being retained in the chronic alcoholic, or that some marked redistribution of K, associated with altered cell membrane permeability, has occurred.

Bianco and Jolliffe(8) have pointed out that quantitative anemia occurred in 61% of 184 cases of alcoholic addiction, which is not surprising in view of possible complications (stomatitis, pellagra, cirrhosis etc.). In this study average reduction in hematocrit from the control equaled 5% in the alcoholics. While this value was not seriously low (42%), it constitutes a statistically significant departure from the control.

Summary. Plasma and erythrocyte Na, K and Cl have been determined in 64 long-term chronic alcoholics before administration of therapy. Plasma Na, K, Cl and red blood cell Cl were significantly reduced below control values. Erythrocyte K was significantly elevated, while Na remained unchanged. Plasma protein concentration and hematocrit were significantly reduced from control values.

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Observations on Vitamin C Activity of D-Ascorbic Acid.* (24827)

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Previous studies have shown marked differences in retention of D-ascorbic acid-1-C^{14} and L-ascorbic acid-1-C^{14} when administered in small intraperitoneal doses to normal and Vit. C-deficient guinea pigs (1). D-Ascorbic acid is rapidly metabolized and excreted; most of the compound disappears from the body within 12 hours after the dose. In contrast, L-ascorbic acid is

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