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Research Article

STUDIES ON ALCOHOL DIURESIS. I. THE EFFECT OF ETHYL ALCOHOL INGESTION ON WATER, ELECTROLYTE AND ACID–BASE METABOLISM[1, 2]

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The diuresis following the ingestion of alcohol has been compared with the increased urine flow secondary to water ingestion (1). Van Dyke and Ames (2) demonstrated that the injection of small amounts of alcohol (12 to 50 mg. per Kg.) into the carotid artery of normal unanesthetized dogs evoked a prompt diuresis without any detectable alcohol in the systemic venous blood. No increased diuresis occurred in dogs with diabetes insipidus following intracarotid injection. As alcohol has no direct effect on exogenous antidiuretic hormone (ADH), or on the responsiveness of the renal tubules to this hormone (3), most investigators agree that "alcohol diuresis" is probably due to suppression of the release of ADH. Little attempt has been made, however, to correlate simultaneously its effect on water excretion with electrolyte excretion, acid-base changes, and alterations in blood volume.

The study was divided into three parts: Part I. Effect of alcohol ingestion on water, electrolyte, and acid-base metabolism in semi-recumbent hydrated normal subjects; Part II. Evaluation of the inhibition of ADH secretion by alcohol, in normal subjects in whom acute changes of extracellular fluid tonicity and "effective circulating blood volume" were induced; Part III. Evaluation in pathologic states in which abnormal function of the neurohypophyseal system had been demonstrated or postulated.

MATERIALS AND METHODS

The subjects were three normal males, on unrestricted diets, ages 29 to 30. From 7:00 to 7:30 A.M. on the morning of each experiment the subject ate a light breakfast, including 400 to 800 cc. of fluid. At 8:30 the subject emptied his bladder, was weighed, and assumed the semi-recumbent position, standing to void at one-half to hourly intervals. Each experiment lasted from three to five hours. Fifty cc. of H_2O were ingested hourly to cover approximately the insensible water losses. Venous blood was drawn under oil, without stasis, shortly after reclining or just prior to alcohol ingestion and at two-hour intervals thereafter. When alcohol was imbibed, additional samples were taken every half-hour for the determination of alcohol. In all experiments an indwelling Cournand needle was inserted to avoid the trauma of multiple vena punctures.

Two or three control experiments and two alcohol experiments were done on each subject. One hundred and twenty cc. of 100 proof Kentucky bourbon (approximately 48 grams of ethyl alcohol) were imbibed over a five to ten-minute period one and a half hours after reclining. In the control studies 120 cc. of water were ingested.

Sodium, potassium, chloride, and pH of serum, and sodium, potassium, chloride, pH, ammonia, and titratable acids of urine were measured by methods that have been described in previous reports from this laboratory (4, 5). Creatinine of serum and urine was determined by a modification of the method of Hare (6), blood alcohol by the method of Lester and Greenberg (7). In some experiments the osmolarity of serum was estimated from the depression of the freezing point measured by means of a Fiske osmometer.

Calculations

a) Changes in plasma volume were calculated by the formula:

$$\frac{PV_2}{PV_1} = \frac{(1 - Hct._2)}{(1 - Hct._1)} \times \frac{Hb._1}{Hb._2} \times 100 \qquad (8)$$

PV. = plasma volume, Hct. = hematocrit (vol. per 100 cc.)

Hb. = hemoglobin (grams per 100 cc.)

b) Urine volume was divided into two moieties as described by Wesson (9). One is represented by the volume of water required to make the urine solutes isosmotic with the plasma. This is designated *osmolar clearance* (C_{osm}), and is represented by the equation:

$$C_{osm} = \frac{U_{osm}V}{P_{osm}}$$

V = urine volume per min. U_{osm} = urine osmolarity in

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mOsm. per Kg. urine H_2O. P_{osm} = plasma osmolarity in mOsm. per Kg. plasma H_2O.

The other moiety represents the net excess or deficit of water beyond the osmolar clearance, and is designated free water clearance (C_{H_2O}). It is represented by the formula $C_{H_2O} = V - C_{osm}$. The urine volume, $V = C_{osm} + C_{H_2O}$. Free water clearance is positive when the urine is diluted below the isosmotic state by the contribution of water virtually free of solute, and negative when the urine is concentrated by the reabsorption or removal of water free of solute as in antidiuresis. This definition of free water clearance should not be construed as indicating the exact mechanism by which the urine is concentrated or diluted.

Reference should be made to the contribution of ethyl alcohol to the osmolarity of plasma and urine. At the concentrations of alcohol found in the present study the depression of the freezing point was proportional to the mole fraction of alcohol in these fluids, *i.e.*, one millimol of alcohol was equivalent to one milliosmol. Alcohol is diffusible throughout the total body water, and its concentration in serum water and urine is essentially the same. It appears to move freely in both directions across the cells of the renal tubule independent of the flow of urine and the excretion of other solutes (10) and to have no affect on the osmotic distribution of water. For this reason it seemed appropriate to subtract the osmolar contribution of alcohol from the total osmolarity of serum and urine prior to calculating osmolar clearance (C_{osm}).

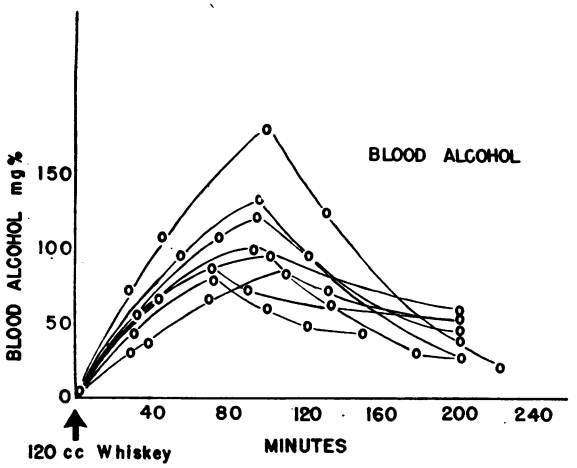

FIG. 1. THE PATTERN OF CHANGES IN ALCOHOL LEVELS IN THE BLOOD AFTER INGESTION

The prealcohol concentration was assumed to be zero.

RESULTS

Blood alcohol (Figure 1)

The concentration of alcohol in the blood rose progressively during the first sixty to ninety minutes after its ingestion. The mean concentration

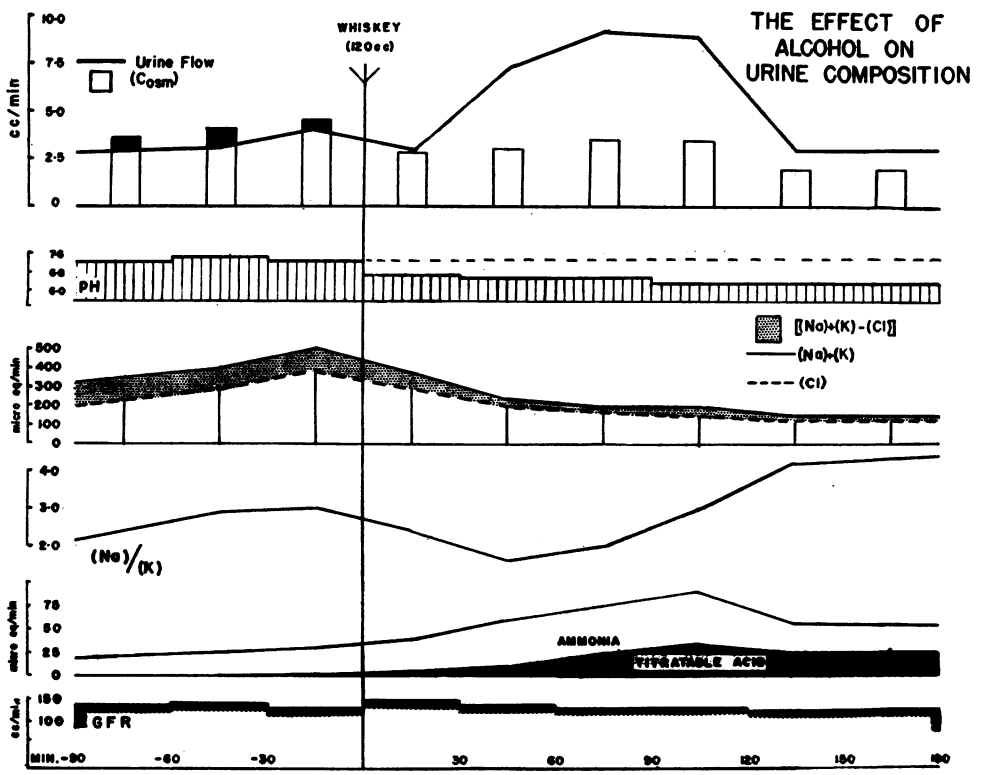

FIG. 2. THIS FIGURE ILLUSTRATES THE CHARACTERISTIC CHANGES IN URINARY COMPOSITION FOLLOWING THE INGESTION OF ALCOHOL

at ninety minutes was 110 mg. per cent with a range of 60 to 180 mg. per cent. It fell gradually in a course resembling an exponential curve. Three hours after ingestion 25 to 50 mg. per cent of alcohol remained in the blood. The characteristics of the curves of the blood alcohol were similar to those noted by Haggard, Greenberg, and Carroll (10). The rise in concentration of alcohol in the blood was attended by mild inebriation.

In comparison with the control studies, two major changes occurred following the imbibition of alcohol: 1) Increased urine flow with decreased solute excretion; and 2) extracellular acidosis with increased excretion of titratable acid and ammonia. The typical changes in urine composition are illustrated in Figure 2.

In all studies (Tables I and II) only minor fluctuations in creatinine clearance occurred, and these could not be correlated with changes in urine flow or solute excretion. The failure of alcohol in doses comparable to those used in the present study to alter glomerular filtration rate has been previously demonstrated (3).

Urine flow (Table I and II)

In the control experiment, under the conditions of the present study, diurnal variation and the assumption of the semi-reclining position led to two to threefold rises in urine flow. In contrast, in five of the alcohol studies urine flow increased three to tenfold. In one experiment, R.9/17, urine flow did not rise after alcohol ingestion. This subject's rate of excretion of sodium was much lower than any other in the present study. This is consistent with the observations of Rosenbaum and his co-workers (11) in which urine flow after water loading was correlated with the renal excretion of solutes.

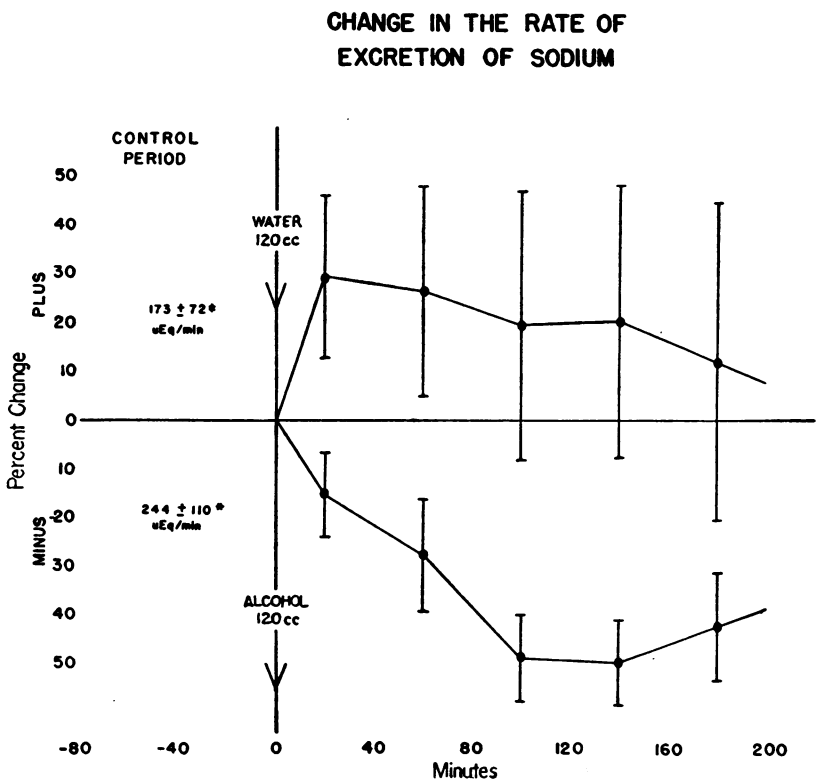

FIG. 3. THE EFFECT OF ADMINISTRATION OF ALCOHOL ON THE EXCRETION OF SODIUM

The vertical brackets at each point represent twice the standard error of mean. Note that there is no overlap between the control subjects and those receiving alcohol.

* The mean rate of excretion of sodium with 2 × the standard deviation during the initial period.

TABLE I

Control studies

Subject Date	Time	Urine pH	Urine Excretion rates/min. Na	K	Cl	NH_3	TA	Osm.*	Vol.	Clearances/min. Osm.	Free	Creatinine	Blood Na	K	Cl	CO_2	pH	Osm.
	Min.	*Units*	*μEq.*	*μEq.*	*μEq.*	*μEq.*	*μEq.*	*μOsm.*	*cc.*	*cc.*	*cc.*	*cc.*	*mEq./L.*	*mEq./L.*	*mEq./L.*	*mEq./L.*	*Units*	*mOsm./L.*
K. 8/20	60	7.31	304	101	296	18	1	(1,210)	1.7	4.0	−2.3	141			105.2			
	32	7.16	384	136	390	21	3	(1,260)	4.0	4.2	+0.1	149						
	60	6.87	255	103	285	22	3	(1,090)	4.9	3.6	+1.3	140	140.6	3.78	102.5			
	60	6.16	145	71	176	26	15	(970)	1.2	3.2	−2.0	139						
	60	6.27	154	48	151	23	15	(900)	1.0	3.0	−2.0	143	142.0	3.60	102.0			
L. 8/26	90	6.38	91	90	143	41	6	(880)	1.5	2.9	−1.4	134	140.8	3.55	100.7			
	60	7.00	117	137	201	37	4	(1,100)	3.2	3.7	−0.5	140	140.8	3.72	102.0			
	60	7.42	110	107	150	21	0	(920)	1.4	3.1	−1.7	128						
	60	7.18	140	157	163	26	2	(1,280)	2.1	4.3	−2.2	143	135.9†	3.42†	103.5†			
R. 8/20	65	6.05	158	41	156	29	14	(810)	1.3	2.7	−1.4	151	139.4	3.52	102.5			
	30	5.89	150	43	144	23	14	(780)	2.6	2.6	±0.0	144						
	60	6.65	194	46	187	26	6	(950)	3.5	3.2	+0.3	132	138.8	3.82	103.2			
	65	6.77	210	37	207	32	9	(1,000)	2.9	3.3	−0.4	133						
	60	6.84	183	36	196	32	6	(950)	3.3	3.0	+0.3	129	141.0	4.10	104.7			
L. 8/24	180	6.18	81	43	82	40	19		0.9			120	140.8	3.82	101.7			
	60				107				1.6				139.7	3.92	100.7			
	60	6.47	116	64	162	42	14		1.9			121						
	60	6.60	171	108	211	46	17		1.3			148	139.0	3.48	100.0			
R. 9/14	65	5.69	126	56	166	23	15	820	0.8	2.7	−1.9	153	137.0	4.20	102.0			302
	61	7.89	264	101	274	7	0	1,190	1.4	4.0	−2.6	144						
	57	7.81	305	96	312	9	0	1,240	1.3	4.1	−2.7							298
	59	5.87	188	90	246	22	15	1,170	1.0	3.9	−2.9							
K. 9/14	65	7.49	242	158	292	24	0	1,200	2.1	4.0	−1.9	148	141.5	3.65	100.0			300
	60	7.30	278	119	328	36	1	1,225	4.3	4.1	−0.2	138						299
	50	7.18	241	93	271	24	1	1,016	2.0	3.4	−1.4							
K. 10/28	64	7.51	237	103	252	7	0	1,013	3.6	3.8	−0.2	112	139.1	3.75	98.0	27.6	7.44	283
	54	7.42	247	102	249	21	0	998	4.9	3.6	+1.4	114	139.1		102.0	27.5	7.43	280
	66	7.26	180	78	179	14	0	738	1.2	2.6	−1.4	113	139.1	3.75	101.0	27.5	7.41	281
	62	7.41	140	66	117	12	0	620	0.8	2.2	−1.4	105						
R. 8/19	55	6.44	207	37	201	44	8	(823)	2.4	2.7	−0.3	134	138.5		101.1			
	65	7.44	298	36	258	11	0	(1,034)	3.2	3.4	−0.2	128						
	65	7.10	246	39	194	23	7	(793)	4.5	2.6	+1.9	123	138.5	3.92	103.0			
	55	6.85	238	44	237	22	9	(808)	3.0	2.7	+0.3	141	139.0	3.95	102.7			

* The values in parentheses were determined by plotting the measured osmolarity against the sum of $[Na^+] + [K^+] + [NH_4^+]$ on three separate graphs (dilute, very concentrated and post alcohol urines). Those urines on which osmolarity had not been measured were then determined by reading off the appropriate graph. A variation of ±15 per cent makes essentially no difference in the free water clearance (C_{H_2O}).

† Arterial blood.

TABLE II

Alcohol studies

Subject Date	Time	Urine										Blood						
			Excretion rates/min.							Clearances/min.							Osmolarity	
		pH	Na	K	Cl	NH_3	TA	Osm.*	Vol.	Osm.	Free	Creat.	Na	K	Cl	Alcohol	pH	Observed	Correct†
	Min.	*Units*	*μEq.*	*μEq.*	*μEq.*	*μEq.*	*μEq.*	*μOsm.*	*cc.*	*cc.*	*cc.*	*cc.*	*mEq./L.*	*mEq./L.*	*mEq./L.*	*mg. %*	*Units*	*mOsm./L.*	*mOsm./L.*
K.8/18	88	7.36	340	78	276	14	0	(1,270)	3.7	4.5	− 0.8	143	140.2	3.62	100.0	88			
	60‡	6.62	256	76	285	26	8	(1,084)	5.8	3.8	+ 2.0	151				134			
	32	6.17	218	71	252	32	17	(1,070)	13.9	3.7	+10.2	147	141.2	4.02	100.0	138			
	30	6.13	209	54	233	31	18	(1,050)	12.2	3.7	+ 8.5	136				94			
	60	5.19	228	39	248	34	8	(1,157)	4.5	4.1	+ 0.4	141	142.5	3.75	98.5	42			
																56			
L.8/18	70	7.40	221	47	238	29	0	(1,060)	1.2	3.5	− 2.3	143	140.0	3.82	95.0				
	60‡	6.40	257	81	307	52	5	(1,300)	5.6	4.2	+ 1.4	156				80			
	35	5.40	145	44	191	48	13	(948)	12.4	3.1	+ 9.3	136	139.0	3.55	95.5	58			
	54	5.20	139	30	173	34	15	(880)	3.2	2.9	+ 0.3	133				62			
	71	5.70	157	46	206		7	(940)	1.3	3.1	− 1.8	146	140.0	3.70	100.0	32			
L.9/30	87	7.40	226	188	297	15	0	1,380	1.5	4.4	− 2.9	124	136.0	3.65	98.0	58	7.54	286	286
	79‡	6.40	176	115	241	44	13	1,160	2.9	3.8	− 0.8	128	134.0	3.40	98.0	84	7.49	307	287
	68	5.90	61	32	65	40	24	800	4.8	2.6	+ 2.1	118	139.0	3.56	99.5	53	7.27	300	288
	34	5.70	78	26	68	37	36	705	2.3	2.3	± 0.0	131							
	27	5.60	116	30	76	24	4	802	1.1	2.7	− 1.6		139.0	3.65	99.0	43	7.41	300	290
K.10/15	38	7.29	243	93	231	11	0	1,021	2.6	3.4	− 0.8	142	134.4	4.28	100.0		7.50	296	
	34	7.41	306	106	287	11	0	1,138	2.9	3.8	− 0.9								
	39‡	7.32	386	132	385	15	0	1,403	4.0	4.3	− 0.3	146							
	30	7.20	248	104	282	17	2	1.027	3.0	3.4	− 0.4	137	132.8	4.00	106.0	46	7.44	305	295
	28	6.47	150	90	205	26	5	982	7.5	3.2	+ 4.3	140				84	7.42		
	32	6.37	138	66	183	25	13	1,090	9.0	3.5	+ 5.5	136	139.1	4.00	107.0	102	7.35	310	290
	30	6.42	146	49	157	25	19	1,100	9.2	3.5	+ 5.7	125	139.8	4.15	107.5	80	7.34	314	296
	61	6.20	124	30	133	16	13	644	3.1	2.0	+ 1.1	127	137.8	4.28	103.0	55	7.41	302	296
																28			
R.8/27	88	7.39	202	57	173	13	0	(820)	1.0	2.8	− 1.8	136	138.5	4.02	106.0		7.41		
	36‡	7.34	189	52	169	11	0	(840)	1.5	2.8	− 1.3	145				118			
	29		136	41	144	20		(704)	2.1	2.3	+ 0.2	140	138.5	3.90	103.2	100	7.40		
	28	5.50	133	56	146	34	9	(892)	5.4	2.9	+ 2.5	149				174	7.33		
	35	5.41	82	37	76	27	7	(1,074)	4.9	3.3	+ 1.6	130				120			
	27	5.35	92	12	77	17	13	(550)	1.7	1.7	± 0.0	146							
	33	5.41	92	12	72	10	27	(550)	0.6	0.6		138	140.0	4.15	103.7	40	7.35		
R.9/17	70	6.50	94	45	103	17	8	790	0.7	2.6	− 1.9	115	139.5	3.95	102.0			300	
	78‡	5.60	69	32	81	22	11	684	1.0	2.2	− 1.2	117	139.0	4.12	103.5			322	310
	112	5.00	59	30	68	24	27	690	0.9	2.3	− 1.4	119	140.2	3.75	105.5			314	300
	230		72	23	69	26		760	0.5	2.8	− 2.0								

* See Footnote, Table I.

† Observed osmolarity—osmolar contribution on alcohol.

‡ Alcohol imbibed at beginning of this period.

Solute excretion (Tables I, II, and Figure 3)

In Figure 3 the differences in the excretion of sodium between the control and alcohol experiments are plotted as a per cent change from the control period. The pattern of the excretion of sodium in the control subjects reflected the effect of the semi-recumbent position (12) and diurnal variation (13). It is apparent that a prompt fall in the excretion of sodium followed the ingestion of alcohol. This fall preceded the rise in urinary flow in most instances and persisted after the flow returned to prealcohol rates. Although the rates of excretion of potassium and chloride (Tables I, II) are not plotted, they also fell promptly after imbibition of alcohol. The early fall in the (Na)/(K) ratio after alcohol (Figure 2) appeared to indicate a greater effect on the excretion of sodium. In the control subjects sodium + potassium − chloride initially rose, with a subsequent fall. In the subjects receiving alcohol, sodium + potassium − chloride fell progressively (Tables I, II, and Figure 2). A temporally related rise in ammonia and titratable acid excretion (Tables I, II, and Figure 2) accounted for only a small portion of the diminished excretion of sodium and potassium. The percentage fall in solute excretion of Subject R.9/17, who had no diuresis following alcohol ingestion, was as great as that in the other alcohol experiments. This response is similar to that seen in one subject reported by Eggleton and Smith (14) who, in spite of a minimal diuresis following the ingestion of alcohol, had a definite fall in chloride excretion. The reversal of the morning diurnal pattern of the electrolyte excretion (13) is indicative of the "potency" of the physiologic stimulus of alcohol.

Partition of water excretion

In Figure 4 are plotted the mean changes in free water clearance (C_{H_2O}). In the control group a slight rise occurred in the first hour after the control period, followed by a gradual decline. The slight increase in urinary flow in the control subjects reflected a parallel rise in osmolar and

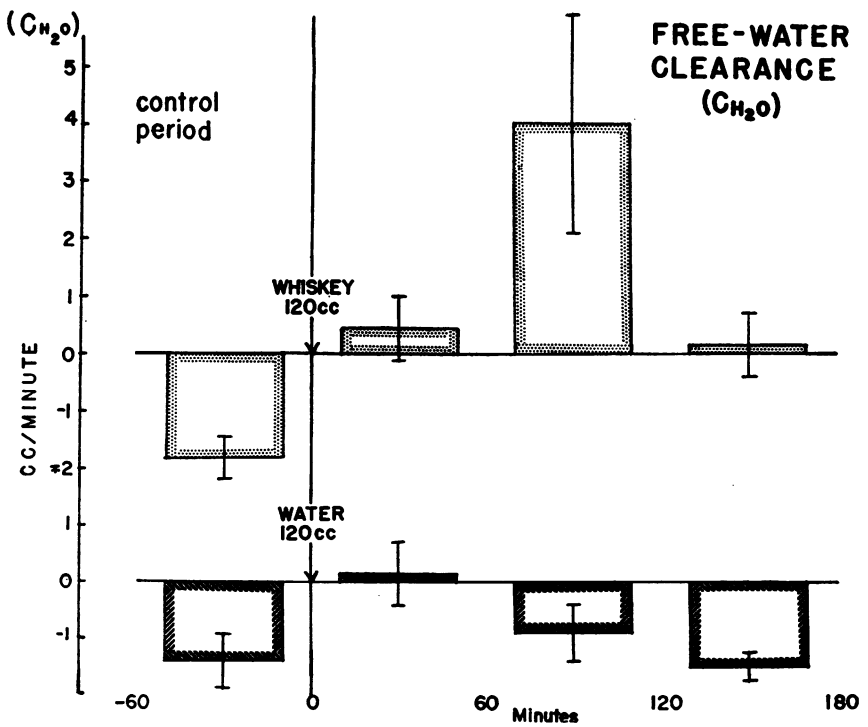

FIG. 4. A COMPARISON OF THE EFFECT OF 120 CC. OF ALCOHOL AND WATER ON THE FREE WATER CLEARANCE (C_{H_2O})

The vertical bracket at the top of each block represents 2 × the standard error or mean.

TABLE III

A comparison of the changes in serum electrolytes and plasma volume after ingestion of 120 cc. of alcohol or water

Time after ingestion	Measurement	After alcohol		After water	
		No. of obs.	Mean change from control period in mEq./L. with S.D.	No. of obs.	Mean change from control period in mEq./L. with S.D.
1 hr.	Sodium	8	1.2 ± 0.7	5	−0.3 ± 0.2
	Potassium	8	−0.19 ± 0.22	4	0.13 ± 0.05
	Chloride	8	1.2 ± 1.0	6	0.5 ± 1.0
	%Δ P.V.	4	%Δ 4.3 ± 0.7	5	%Δ 3.1 ± 1.4
2 hr.	Sodium	8	1.6 ± 0.5	4	0.1 ± 0.7
	Potassium	8	−0.17 ± 0.16	5	−0.01 ± 0.16
	Chloride	8	1.6 ± 0.9	6	0.6 ± 1.1
	%Δ P.V.	4	%Δ 4.3 ± 0.7	4	%Δ −0.1 ± 2.7*

* In view of the variability in repeated determinations of hemoglobin and hematocrit this 2-hour difference was not considered significant.

free water clearance. In the first thirty to sixty minutes after imbibing alcohol, the rise in free water clearance was associated with a fall in osmolar clearance. The contrast between the two groups was most marked in the period 60 to 120 minutes after alcohol. While the C_{H_2O} was declining in the control studies, a striking further increase occurred in the five experiments in which a diuresis was seen after alcohol ingestion. The free water clearance (C_{H_2O}) accounted for 60 to 80 per cent of the total urine flow. Thus the diuresis following alcohol ingestion was characterized by a decrease in osmolar and an increase in free water clearance. Even in study R.9/17 (Table II), with no obvious diuresis after alcohol, the 30 per cent fall in solute excretion with a 40 per cent rise in free water clearance was consistent with the effect of alcohol in the other studies. The maximum free water clearance coincided with the peak of the diuresis after alcohol.

Acid-base changes

In the present studies a fall in the pH of the blood of 0.13 ± .03 pH units occurred during the first hour after alcohol imbibition. The peak of this acidosis coincided approximately with the greatest concentration of alcohol in the blood, and returned toward normal at the end of the experiments. Bicarbonate of the serum, determined in subsequent studies (15), also fell, and in several instances the calculated pCO_2 (16) rose above the normal mean of 40 mm. Hg. This suggests that the acidosis secondary to alcohol administration is a combined metabolic and respiratory acidosis. Seligson and his co-workers (17) and Nicholson and Taylor (18) have described a moderate metabolic acidosis following the ingestion of alcohol.

Blood volume changes (Table III)

In the control studies calculated plasma volume rose slightly after the assumption of the semi-recumbent position. It did not increase significantly after imbibition of alcohol. In one alcohol experiment the slight increase determined by the Hb.-Hct. method was confirmed by the radioactive chromium technique (19).

DISCUSSION

In the present study water diuresis is best characterized as a rise in free water clearance. If the assumption is made that in the normal kidney this moiety of water can only increase when there is a decrease in circulating ADH or a decreased responsiveness of the renal tubules to ADH, alcohol must exert its effect through one or both of these mechanisms. Strauss, Rosenbaum, and Nelson (3) and Eggleton (1) have shown that following the administration of alcohol the renal tubule is capable of responding to exogenous antidiuretic hormone. The conclusion that alcohol acts directly on the supraoptico hypophyseal system is convincing. Acetyl choline and nicotine are strong chemical stimulators of ADH release. Eggleton (1) demonstrated that nicotine administered prior to ingestion of alcohol could prevent the expected diuresis. Van Dyke and Ames (2)

were able to block the effect of acetyl choline by the prior administration of alcohol. Finally, the ability to produce a characteristic water diuresis by the intracarotid injection of relatively minute quantities of ethyl alcohol (2) would appear to localize conclusively its site of action.[5]

The peak of the diuresis or free water clearance 60 to 90 minutes after alcohol ingestion coincided with the peak level of alcohol in the blood (Figure 1). The onset of the alcohol diuresis and the characteristics of the diuretic curve were shown by Eggleton (1) to be very similar to those following a load of water. The time lag of sixty to ninety minutes probably is associated with the inactivation of circulating ADH. This lag implies that alcohol must have blocked the release of ADH during the early period of its rise in the blood.

As pointed out by van Dyke and Ames (2) and Eggleton (1) the maintenance of elevated levels of alcohol in the blood does not sustain the diuresis. This is not due to the development of dehydration, since a second dose of alcohol taken after the effects of the first have worn off will lead to a second diuresis, though of lesser magnitude than the first.

A definitive mechanism by which alcohol decreases the excretion of sodium, potassium, and chloride could not be derived from the present study. Alcohol did not cause consistent changes in glomerular filtration rate or in the level of these electrolytes in the serum (Table III). Although the acidosis, with the associated rise in titratable acid and ammonia, would lead to some reabsorption of sodium by the exchange mechanism, quantitatively it could account for, at most, 20 per cent of the retained sodium. A slight degree of dehydration is induced by the loss of water in excess of sodium following alcohol ingestion. Since, however, the initial fall of sodium excretion preceded the rise of free water clearance, the "dehydration reaction" (20) cannot be implicated. Stimulation of the adrenals and inhibition of the posterior pituitary are unlikely causes of the sodium retention as the decrease in the excretion of sodium after alcohol occurred in a patient with Addison's disease on a constant intake of DOCA,[6] and in a case of diabetes inspidus receiving no exogenous ADH (15). Whether this enhanced reabsorption was due to a direct effect of alcohol on the renal tubules is not known. Eggleton and Smith (14) also noted falls in the excretion of chloride following alcohol. Strauss, Rosenbaum, and Nelson (3) failed to observe greater decreases in solute excretion after alcohol than seen in their control group. Their studies were performed in the afternoon, with the subjects in the sitting position; both of these are important differences from the present study. Although the ingestion of alcohol did not cause significant changes in total blood volume (Table III), the peripheral vasodilation following its ingestion must have caused a redistribution of the blood. (It is possible that the latter, by a presently unknown mechanism, was the effective stimulus for the increased tubular reabsorption of sodium and chloride.)

The cause of the potassium retention is also unexplained. However, acidosis *per se* (21) and the intermediary metabolism of the alcohol may be important contributors.

The acidosis, the changes in electrolyte excretion, and the alterations in blood volume and renal hemodynamics cannot be related causally to the diuresis or rise of free water clearance following alcohol ingestion.

SUMMARY AND CONCLUSIONS

The acute effects of alcohol ingestion (120 cc. whiskey) on water and electrolyte metabolism were studied in normal semi-recumbent males during the morning hours.

Alcohol caused a marked rise in urinary flow and free water clearance (C_{H_2O}) as well as consistent falls in the excretion of sodium, chloride, and potassium. Although no definite cause for the fall in solute excretion was discerned it is suggested that a redistribution of blood volume may have been the effective stimulus.

The acidosis, the changes in electrolyte excretion, and the alterations in blood volume and renal hemodynamics could not be causally related to the diuresis or rise of C_{H_2O} after alcohol.

[5] The experiments of van Dyke and Ames (2) were performed on dogs and, while conclusive for this species, their extrapolation to humans should be done with caution.

[6] Administration of ACTH to this patient induced no fall in circulating eosinophils or rise in 17-ketosteroid excretion.

The findings in the present study are consistent with the hypotheses that alcohol inhibits the supraoptico hypophyseal system.

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