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SCHOOL OF AVIATION MEDICINE
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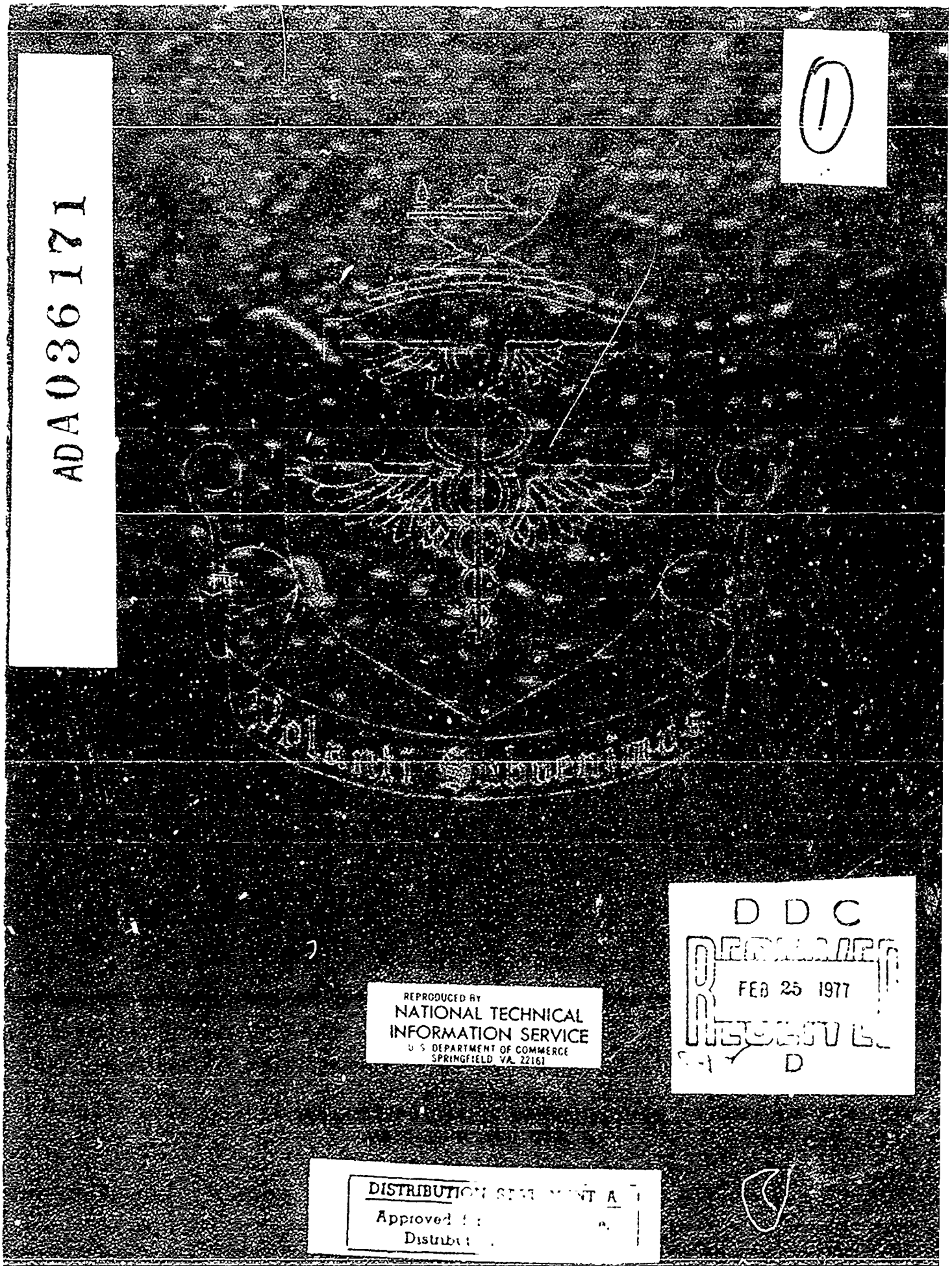

HUMAN PLASMA STEROID AND ELECTROLYTE CONCENTRATIONS BETWEEN 0800 AND 1600 HOURS

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The purpose of the present study was to determine whether or not significant changes would occur in plasma steroid and electrolyte levels as a consequence of a 4-hour sampling procedure. Two venous blood samples were collected from each of 460 healthy young adult males, with a 4-hour interval between samplings.

There was no consistent change in total 17-hydroxycorticoid levels between 0800 and 1600 hours. Very small yet statistically significant increases in plasma sodium were found following the 4-hour periods between samples. Potassium concentration increased in three of the five time groups, only two of these increases being significant.

When it is essential that two blood samples be drawn from each subject in an experiment, it becomes mandatory that the effect of the blood-letting procedures upon the variables under study be thoroughly understood. If the time interval between samples is of considerable length, it then becomes necessary to recognize the possibility of diurnal and emotional responses inherent in such a sampling method.

It was the purpose of the present study to determine if significant changes occurred in certain blood constituents as a consequence of a 4-hour sampling procedure.

PROCEDURE

Venous blood samples were collected from a total of 460 healthy male subjects varying in age from 18 to 22 years. Between 18 and 20 subjects were sampled daily, and, within these groups, homogeneity was strict as to diet, physical activity, and emotional exposure. Two 35 ml. blood samples were taken from each subject, with a 4-hour interval between samplings. The earliest samples were collected at 0800, and the latest were drawn at 1600 hours; thus, overlap was present only in the samples taken at 1200 hours. The sampling was at least 3 hours postprandial in each case. The heparinized blood samples were centrifuged immediately and the separated plasma stored by freezing.

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Plasma total 17-hydroxycorticoid (17-OHCS) determinations were carried out by the method of Reddy et al. (1; as modified (2). Concentrations of sodium and potassium were determined with a Beckman DU flame photometer (spectral energy recording adapter; photomultiplier) utilizing a hydrogen-oxygen flame. Working standards were prepared as serial dilutions from a stock standard containing: sodium, 144 mEq./liter; potassium, 5 mEq./liter; calcium, 5 mEq./liter; phosphorus, 2.2 mEq./liter; and magnesium, 2 mEq./liter. All samples and standards were adjusted to a final 1.0 percent trichloroacetic acid concentration.

RESULTS AND DISCUSSION

An analysis of variance was performed on the data for each variable from each of the time groups to determine if changes occurred in the levels of 17-OHCS, sodium, and potassium from the time the first sample was taken to the time of the second sampling 4 hours later. The results of these analyses are given in tables I to III. In addition, an analysis of variance was performed for each variable on each trial to ascertain if the means differed significantly; these results are shown in the last column of each of the tables. Frequency distributions are listed in table IV.

17-Hydroxycorticoids

Three of the five time groups showed a mean increase for this variable. See table I.

TABLE I

Plasma total 17-hydroxycorticoid concentration between 0800 and 1600 hours

		Means for 17-OHCS concentration (gamma %)			
Time groups	n	Trial 1	Trial 2	S.D.	P*
0800 - 1200	50	41.19	38.63	12.30	N.S.
0900 - 1300	45	42.44	41.51	12.91	N.S.
1000 - 1400	35	36.19	44.49	15.76	<.05
1100 - 1500	43	35.78	39.52	8.56	<.05
1200 - 1600	46	43.23	44.06	12.08	N.S.
	S.D.	17.45	15.76		
	P*	N.S.	N.S.		

*Probability taken from the analysis of variance.

TABLE II

Plasma sodium concentration between 0800 and 1600 hours

		Means for sodium concentration (mEq./liter)			
Time groups	n	Trial 1	Trial 2	S.D.	P*
0800 - 1200	95	144.4	145.2	1.67	<.01
0900 - 1300	102	144.4	145.5	2.01	<.01
1000 - 1400	90	145.0	145.9	2.22	<.01
1100 - 1500	117	144.8	146.7	2.14	<.01
1200 - 1600	56	143.5	144.5	2.09	<.01
	S.D.	4.16	4.35		
	P*	N.S.	<.05		

*Probability taken from the analysis of variance.

TABLE III

Plasma potassium concentration between 0800 and 1600 hours

		Means for potassium concentration (mEq./liter)			
Time groups	n	Trial 1	Trial 2	S.D.	P*
0800 - 1200	95	4.69	4.75	.188	<.05
0900 - 1300	102	4.83	4.83	.193	N.S.
1000 - 1400	90	4.90	4.90	.206	N.S
1100 - 1500	117	4.67	4.75	.199	<.01
1200 - 1600	56	4.49	4.55	.178	N.S.
	S.D.	.408	.404		
	P*	<.01	<.01		

*Probability taken from the analysis of variance.

TABLE IV

Frequency distribution for plasma steroid and electrolyte concentrations between 0800 and 1600 hours

Total 17-OHCS (gamma %)	Number of subjects Trial 1	Trial 2	Sodium (mEq./liter)	Number of subjects Trial 1	Trial 2	Potassium (mEq./liter)	Number of subjects Trial 1	Trial 2
3.0– [illegible]	6	4	133.0–134.9	1	1	3.30–3.79	3	1
9.0– 14.9	6	2	135.0–136.9	10	2	3.80–3.99	22	15
15.0– 20.9	12	12	137.0–138.9	20	14	4.00–4.19	25	24
21.0– 26.9	24	13	139.0–140.9	69	50	4.20–4.39	56	45
27.0– 32.9	50	35	141.0–142.9	95	77	4.40–4.59	68	73
33.0– 38.9	31	39	143.0–144.9	55	57	4.60–4.79	77	81
39.0– 44.9	24	35	145.0–146.9	90	79	4.80–4.99	82	78
45.0– 50.9	33	25	147.0–148.9	43	76	5.00–5.19	58	65
51.0– 56.9	17	20	149.0–150.9	43	46	5.20–5.39	39	46
57.0– 62.9	9	13	151.0–152.9	24	30	5.40–5.59	24	27
63.0– 68.9	6	9	153.0–154.9	8	16	5.60–5.79	6	4
69.0– 74.9	5	5	155.0–157.2	2	12	5.80–5.99	0	1
75.0– 80.9	4	6						
81.0– 86.9	3	0						
87.0–106.2	3	1						
Total	219	219		460	460		460	460

Two of these three mean increases were statistically significant. No significant differences were observed between the five time groups for either of the trials.

Sodium

It was observed that for each of the five time groups under study, the Na level increased significantly during the 4-hour time lapse between samplings (table IV). Further, it can be seen that the mean values for the five first trials did not differ significantly from each other. Yet, for the second trials, there was a significant ($P < .05$) difference in the means.

Potassium

Three of the five time groups showed a mean increase in K during the 4-hour time lapse (table III). Only two of these three mean increases were statistically significant. The variation in first trial means was statistically significant at the 1 percent level. Similar variation was found among the second trial means. Much of this was attributable to the low mean values, first and second trials, for the 1200 to 1600 group.

Reddy et al. (1), reporting total 17-OHCS values on 6 male subjects, found mean levels of 46 gamma percent at 0830 and 18 gamma percent at 1700. Brown et al. (3) found that conjugated 17-OHCS followed the same diurnal pattern as free 17-OHCS (i.e., highest in the morning, with a downward trend throughout the remainder of the day), but that the conjugated steroid level lagged behind the free moiety by a period of 2 to 4 hours. The present study indicated no consistent change in total steroid levels between 0800 and 1600.

Plasma electrolyte levels were shown by Fawcett and Wynn (4) to have no definite diurnal variation. Sodium and potassium levels in 2 individuals were found to remain remarkably constant within the day and over a period of months. In addition, the plasma Na and K ranges in 50 healthy young men and women were shown to be very small. Even though, in the present study, a statistically significant difference was observed between each of the first and second trial sodium means, the actual numerical differences between the means were very small.

SUMMARY

Plasma steroid and electrolyte analyses on 460 healthy young adult males led to the following conclusions:

1. There was no consistent change in total 17-hydroxycorticoid levels between 0800 and 1600 hours.

2. Very small, yet statistically significant increases were found for plasma sodium after 4 hours. No predictable pattern was found for plasma potassium.

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