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Studies in Kidney Function. II. Effect of Posture of Diuresis.

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(Introduced by A. W. Rowe.)

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In the course of studies with the water diuresis test the effect of changes in posture was studied, because of the recorded observation[1] that there is a decided change in urine volume between the horizontal and sitting positions. The postures chosen for this study were the horizontal back, the sitting and the Trendelenberg positions.

Six subjects underwent the whole series of 3 tests each. Six others had done the recumbent and sitting tests in the course of different series of observations. The conditions of the test, however, were identical in the 2 series, with a single exception. In one series the tests were done at weekly intervals, in the other they were done on succeeding days. The method is given in the previous report.[2] Table I shows the results of kidney studies in these subjects by other methods than the diuresis test.

The subjects are classified as were the controls in the previous report,[2] into groups of studied normals and assumed normals. The "studied normal" group (SN) are subjects who have had recent complete physical examinations including extensive kidney tests and who on this basis have been classified as normal. The group of assumed normals (AN) are made up of those who have been normal at previous examinations but where the tests have been so much earlier as to exclude them from the former group. In this group are also put those subjects who had normal kidney tests but who could not be classed as fully normal because they had other defects, which would, however, presumably not affect the renal function. Referring again to Table I, minute traces of sugar and of albumen are not taken as significant as they are generally recognized as being within normal limits. On the above basis 8 of the subjects fall into the SN group and 3 into the AN group.

In the twelfth subject red and white cells were found in the urine sediment. Although the studies of Addis,[3] by detailed sedi-

[1] L'Abbé, Marcel, and Violle, P. L., *Metabolisme de l'Eau*, Paris, Masson et Cu, 1927.

[2] Janney, J. C., and Walker, E. W., *J. Am. Med. Assn.*, 1932, **99**, 2078.

[3] Addis, T., *J. Clin. Invest.*, 1925, **2**, 409.

ment counts and computation, show that considerable numbers of both red and white cells are normal, we have classified him as abnormal because of the lack of accurate cell counts. In other respects he was normal.

The experiment was designed to compare the results of the water diuresis test in the horizontal dorsal position, in the sitting position, and in the Trendelenberg position. In the latter the angle was not very high, about 15%. The conditions of the test were the same as those outlined previously.[2] The tests were done at weekly intervals on 6 of the subjects who did all 3 tests. Six other subjects did the tests in the sitting and horizontal back positions in the course of a different study which did not include the Trendelenberg test. In Table II these figures are shown. The average performance of these tests was 1262 cc., which corresponds very closely to the average of all "S" and "A" cases so far studied, which is 1290 cc. The curves are shown in Fig. 1.

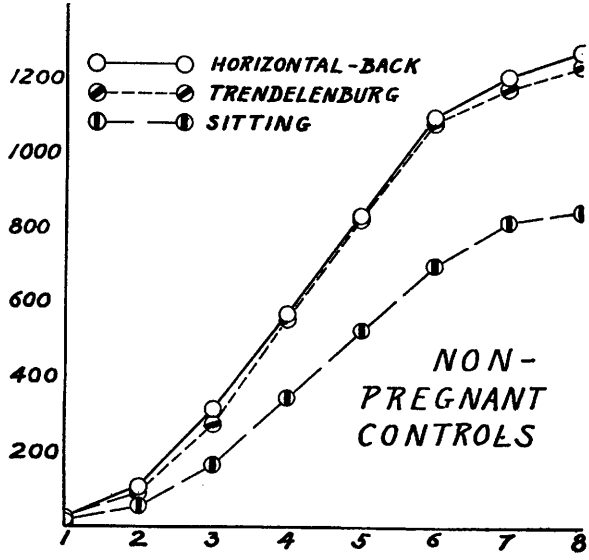

FIG. 1.
Summation curves of the average figures shown in Table II.

Twelve tests were done in the sitting position on 12 different subjects. In all cases there was a cut in urine volume as compared with the individual control reactions of the particular subjects, and also in comparison with the average, of the group. Although there is considerable variation among the individuals the average volume is 823 cc. or 65% of the control figure. Compared to the average normal the output is 64%. It will be noted that the one abnormal sub-

TABLE I. Showing Responses of Subjects to the Investigation of Their Kidney Function.

	Routine Urine	Sediment	Urine Chemistry	N.P.N.	B.U.N.	P.S.P	B.P.	Mosenthal	Differential	Diuresis	Diff.
Studied Normals											
1	Normal	Normal	Normal	39	19	Normal	102			1037	
							—	—	—	—	31
							62			1006	
2	,,	,,	,,	23	11	,,	110			1029	
							—	—	—	—	24
							70			1005	
3	,,	,,	,,	23	11	,,	122			1031	
							—	—	—	—	29
							72			1002	
4	,,	,,	,,	27	13	,,	110			1031	
							—	—	—	—	27
							70			1004	
5	,,	,,	,,	35	18	,,	112			1020	
							—	—		—	17
							76			1003	
6	.43% sugar*	,,	,,	31	16	,,	98	1027		1022	
							—	—	7	—	19
							68	1020		1003	
7	Normal	,,	,,	31	15	,,	122	1032		1024	
							—	—	7	—	21
							78	1025		1003	
8	.42% sugar*	,,	,,	30	15	,,	104	1030		1030	
							—	—	20	—	27
							60	1010		1003	
Assumed Normals											
9	.33% sugar*	,,	,,	40	19	,,	106	1036		1038	
							—	—	5	—	33
							60	1031		1005	
10	Alb. S.P.T. Sug. .31%	,,	High residual N.	27	13	,,	108	1035		1033	
							—	—	14	—	29
							58	1021		1004	
11	.33% sugar*	,,	,,	27	14	,,	96	1037		1029	
							—	—	5	—	25
							58	1032		1004	
12	Normal	Few WBC and RBC	Normal	32	16	,,	112			1032	
							—	—	—	—	27
							76			1005	

*Otherwise normal.

TABLE II.

Responses of Subjects to the Diuresis Test in the Various Positions. Upper figure in the % columns compares the result with this individual control performance. Lower figure compares with 1262 cc., the average control performance. Under present group control the two numbers at the left represent individual tests and the number at the right the average of these tests.

	Present Group Control	Average Normal	Sitting	%	Trendelenberg	%
Studied Normals						
1	750 —— 872 993	—	663	76 — 51	928	107 — 72
2	1529 ——1507 1484	—	944	63 — 73	1273	85 — 99
3	1289 ——1249 1209	—	676	54 — 52	1304	105 — 101
4	931 —— 747 562	—	471	63 — 36	903	121 — 70
5	2035 ——1830 1624	—	1166	64 — 90	1771	97 — 136
6	1407 ——1436 1465	—	1134	79 — 88	—	—
7	1624	—	703	43 — 55	—	—
8	1075 ——1022 979	—	881	86 — 68	—	—
Assumed Normals						
9	1139	—	402	35 — 31	—	—
10	—	—	1260	— — 98	—	—
11	1282 ——1348 1413	—	760	56 — 59	—	—
Average	1262	1290	823	65 — 64	1236	98 — 96
12	1600 ——1385 1170	—	874	63 — 68	1340	97 — 104

ject conforms very well to the performance of the others. The figures for the sitting position and also for the Trendelenberg positions are presented in Table II and in Fig. 1.

The Trendelenberg position test was carried out on 6 subjects only and the volume is almost unchanged from the control figures, a drop

of only 2%, and compared to the general average a drop of 4%. In this test also it will be seen that the single abnormal case conforms well to the performance of the others.

The figures for the test in the sitting position confirm the experience of others and they illustrate well another reason for rest in bed for all cases showing kidney impairment or cardio-renal disease of important extent. Rest in bed is generally recognized as the way to save the heart by cutting down physical exertion. It does this not only by limiting motion and reducing the tissue demand for blood, but also by allowing the heart to do its work at a much lower level of blood pressure than in the upright position. Whereas the average normal blood pressure is 120/80 in the standing position, when the patient is basal it is reduced to 80/50, and even when recumbent without being basal the reduction will approximate about 20/15 points. This not only saves the heart, but it necessitates less capillary and arteriolar constriction and presumably allows more blood flow through the kidneys. Viewed purely from the point of view of a nephropathy without cardiac complications, the better the circulation through the kidney the better opportunity there is for a damaged kidney to do its job.

The close correspondence in output between the horizontal back position and the Trendelenberg position probably depends on the fact that in the latter position the angle of tipping was so low, about 15 degrees. Had it been greater we feel that the results would have shown a figure more closely approaching that found in the sitting position.

Summary. It has been shown with a group of normal subjects that the volume response to a water diuresis test is greater in the horizontal than in the sitting posture. The Trendelenberg position was also used and gave values slightly different from those in the horizontal position, and in the expected direction. The theoretical importance of the horizontal position, aside from the saving of effort, has been discussed relative to kidney disease and the toxemias of pregnancy.