SHORT COMMUNICATION

Effect of posture on renal lithium clearance

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Summary

1. Renal lithium clearance in healthy men was elevated while the subject was reclining, decreased upon standing and increased upon lying down during 45-60 min tests.
2. Parallel changes in renal clearance of creatinine, sodium and potassium, and urine flow rate occurred in response to the changes in posture.
3. The findings demonstrate for the first time that posture is a factor that can influence lithium excretion. Control of posture during lithium excretion tests is recommended.

Key words: lithium excretion, posture, reclining, standing.

Introduction

The recent widespread use of lithium salts as drugs has stimulated interest in the elimination of lithium in the urine. Short-term lithium excretion tests have been used: (1) to determine whether a particular patient can be expected to respond favourably to lithium salt therapy, (2) to determine the dosage of lithium salt needed to obtain a particular serum lithium concentration, (3) to compare renal lithium elimination in different patient groups, and (4) to investigate the effect of lithium administration on kidney function. It is known that the sodium intake, the time of testing, the clinical condition, diuretic drugs, motor activity, sex and age can affect renal lithium elimination in man (Fyrø & Sedvall, 1975). Since these factors can influence the results of a short-term lithium excretion test, they must be either carefully controlled or, at least, taken into account so that the results obtained can be properly interpreted. In the present study, we investigated whether posture can influence renal lithium elimination during a short-term test.

Subjects and methods

The two authors were the subjects in the study. We are healthy males, 30 and 42 years old and weighing 64 and 62 kg respectively. Six clearance tests were carried out on each of us, with at least 1 week between each test. Three conventional Li₂CO₃ tablets (total dose: 900 mg, 24.3 mmol, of lithium) were taken at 22.00 hours on the evening before the test. A standardized breakfast was eaten at about 08.00 hours on the morning of tests. No caffeine-containing beverages were drunk. Water (250 ml) was drunk at 09.45, 10.30 and 11.15 hours on test days to promote urine flow. Blood samples were taken either from the vena cubiti or from the ear lobe at 10.10 and 12.30 hours on test days. The first urine collection period in each test lasted 45 min, during which time we either reclined or stood quietly in a room maintained at 22°C. The posture assumed during this period was determined by the schedule: stand, recline, recline, stand, recline, stand. At 11.15 hours we abruptly changed from reclining to standing or vice versa, and collected urine every 15 min for 1 h in the newly assumed posture. The volume of urine excreted during each collection period was measured. The concentrations of lithium (Amdisen, 1967), sodium and potassium in serum and urine were determined by flame photometry. The
TABLE 1. Effect of posture on renal clearance of lithium, creatinine, sodium and potassium and on urine flow rate

Results are mean values ± SEM for six determinations. * Significant difference (P<0.05) from the 0-45 min value obtained in the alternative posture.

<table>
<thead>
<tr>
<th>Posture</th>
<th>Urine collection period (min)</th>
<th>Lithium (ml/min)</th>
<th>Creatinine (ml/min)</th>
<th>Sodium (ml/min)</th>
<th>Potassium (ml/min)</th>
<th>Urine flow rate (ml/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reclining 0-45</td>
<td>35.4±5.0 10 120±12</td>
<td>1.8±0.2 24.4±3.2</td>
<td>6.9±1.2</td>
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</tr>
<tr>
<td>Standing 45-60</td>
<td>35.6±2.4 27.2±2.1</td>
<td>1.7±0.2 28.8±4.8</td>
<td>9.5±1.2</td>
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<td></td>
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</tr>
<tr>
<td>Standing 60-75</td>
<td>28.0±1.4 27.6±2.0</td>
<td>1.2±0.2* 20.2±1.9</td>
<td>8.1±1.1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Standing 75-90</td>
<td>25.3±1.7* 32.6±2.0</td>
<td>0.9±0.2* 17.0±2.1*</td>
<td>5.4±0.4</td>
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</tr>
<tr>
<td>Standing 90-105</td>
<td>18.6±2.5* 36.8±3.8*</td>
<td>0.5±0.1* 11.1±1.7*</td>
<td>1.9±0.5*</td>
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</tr>
<tr>
<td>Standing 0-45</td>
<td>25.3±3.1 36.8±3.8</td>
<td>1.1±0.2 18.6±2.4</td>
<td>2.9±0.6</td>
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<tr>
<td>Standing 45-60</td>
<td>27.2±2.1 36.8±3.8</td>
<td>1.0±0.2 18.6±2.2</td>
<td>5.8±1.3*</td>
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<tr>
<td>Standing 60-75</td>
<td>32.6±2.0 36.8±3.8</td>
<td>1.4±0.2 23.6±3.8</td>
<td>8.1±1.1*</td>
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</tr>
<tr>
<td>Standing 75-90</td>
<td>33.1±1.7* 36.8±3.8</td>
<td>1.5±0.2 24.1±3.4</td>
<td>9.9±0.6*</td>
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<td>Standing 90-105</td>
<td>36.8±3.8* 36.8±3.8</td>
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</tbody>
</table>

creatinine concentration in the serum and urine was determined by the alkaline picrate method. Representative serum concentrations were calculated and used in the clearance determinations. We used t-tests for non-independent data and de Jonge's trend test (Rümke & de Jonge, 1964) to determine whether results were statistically significant (P<0.05).

Results

The results appear in Table 1. During the initial 45 min collection period, renal lithium clearance was significantly higher while reclining than while standing. Renal lithium clearance declined significantly after posture was changed from reclining to standing and it rose significantly after a change from standing to reclining.

The renal clearances of creatinine, sodium and potassium and urine flow rate were significantly elevated while reclining compared with while standing during the initial 45 min collection period. A change in posture from reclining to standing led to a significant decline in the renal clearance of creatinine, sodium and potassium and in urine flow rate, while a change from standing to reclining caused all parameters to rise significantly, except for creatinine clearance.

In order to determine whether a decrease in effective plasma volume is involved in the fall in lithium clearance induced by standing, we carried out six experiments in which we stood up to our neck in water at 35°C (Epstein, Pins, Arrington, Denunzio & Engstrom, 1975) for four consecutive 15 min periods that began immediately after reclining for 45 min. Standing in the water completely prevented the fall in renal lithium clearance induced by standing. Renal lithium clearance after 15, 30, 45 and 60 min standing in water was 36.0±4.1, 35.2±5.6, 36.2±6.5 and 39.0±6.2 ml/min (mean values ± SD) respectively.

Discussion

We found that lithium clearance was 30% lower while standing than while reclining. We also observed that a change in posture caused the renal lithium clearance to change; it increased upon lying down and decreased upon standing up. Since variation in the time of testing, sodium intake, motor activity, clinical condition, use of diuretic and other drugs, age and sex did not apply in the present study, we conclude that the differences between the lithium clearance while standing and the lithium clearance while reclining were directly due to the differences in posture. Thus our findings show that posture affects renal lithium clearance in man; this has not been demonstrated previously.

In only three out of twenty published reports was posture said to be controlled during the measurement of lithium excretion. Since the present study shows that posture can affect renal lithium clearance significantly during a short-term excretion test, we recommend that posture be carefully controlled in future studies on renal lithium excretion in man.
We observed effects of posture on the renal clearances of creatinine, sodium and potassium and on urine flow rate. Since our experimental design has not been used previously, the details of our results cannot be compared directly with those obtained by others. It is sufficient to point out that the decline in glomerular filtration rate (creatinine clearance), sodium and potassium excretion, and urine flow rate seen in the present study 15–60 min after standing up are well-established findings (Wesson, 1957; Cohen, Conn & Rovner, 1967).

Although the exact mechanism for the decline in glomerular filtration rate, lithium, sodium and potassium excretion, and urine flow upon standing is unsettled, a decrease in effective plasma volume appears to be involved in these phenomena since standing in water up to the neck prevents the decline typically induced by standing (Crane & Harris, 1971, 1973).

Acknowledgments
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References