Polyuria Among Patients With Psychosis

by W. Victor R. Vieweg, Joseph J. David, Joseph L. Glick, Wilma T. Rowe, Randell T. Curnow, Mark D. Lawrence, Joseph J. Yazel, and Wilford W. Spradlin

Abstract

Using the criterion of early morning urinary specific gravity (SPGR) of 1.008 or less to define the presence of polyuria, we identified 26 of 72 male (36 percent) and 14 of 31 female (45 percent) institutionalized chronically psychotic patients as polyuric during a comprehensive survey of one of the chronic care units at a State mental hospital. Factors including diagnosis, sex, age, weight, and serum sodium did not distinguish the polyuric from the nonpolyuric patients. For men, administration of lithium was associated with polyuria. Urinary creatinine concentration (UCR) correlated well with SPGR, and UCR may provide an alternate index to separate polyuric from nonpolyuric patients. The clinical implications of our findings are discussed.

Hoskins and Sleeper (1933) were the first investigators to evaluate chronically psychotic patients for polyuria. Using frequent catheterizations, they found that male patients with schizophrenic disorders excreted about twice as much urine per day (2,602 ml) as normal male controls (1,328 ml). In this study, 55 percent of their patients excreted more than 2,000 ml of urine daily in contrast to only 19 percent of controls who exceeded this amount (Sleeper and Jellinek 1936). In 1979, Jos and Perez-Cruet reported a 6.6 percent prevalence of "compulsive water drinking" among State mental hospital patients, with one half of them experiencing symptoms of "water intoxication." More recently, Blum and Friedland (1983) found that 17.5 percent of male psychiatric patients in a large Veterans Administration hospital had a urinary specific gravity of 1.008 or less, and this criterion was used to establish a diagnosis of "chronic psychogenic polydipsia."

More recently, Lawson, Karson, and Bigelow (1985) attempted to replicate, in the drug era, the work of Hoskins and Sleeper (1933). The mean daily urine volume for patients with schizophrenic disorders was reported as 2,319 ml compared with 1,054 ml for nonschizophrenic patients and 1,265 ml for a normal population. If the daily urine volume was more than 600 ml or if the nursing staff judged the volumes to be complete, the data were used in their report. This article seems methodologically flawed because of the very low measurement of daily urinary creatinine of 857 ± SD 375 mg for 28 male and 7 female patients with schizophrenic disorders. The point to be made is that even careful investigators may underestimate daily urine volume among chronically psychotic patients despite the use of currently acceptable techniques to measure daily urine volume.

Our recent interest in patients with psychosis, intermittent hyponatremia, and polydipsia (PIP syndrome) (Vieweg et al. 1984a, 1984b, 1985a, 1985b, 1985c) has stimulated us to estimate the prevalence of polyuria among patients with chronic psychosis, most of whom have a schizophrenic disorder. Using the criterion of early morning urinary specific gravity (SPGR) of 1.008 or less to define polyuria, we found that 36 percent of male and 45 percent of female institutionalized chronically psychotic patients were polyuric.

Methods

Seventy-two men (mean age 37.6 ± SD 11.7 years) and 31 women (mean age 47.0 ± SD 10.3 years) residing...
in one of the chronic care units at Western State Hospital made up the study population. Psychosis was present in all patients, and DSM-III criteria were used to establish specific diagnoses (American Psychiatric Association 1980).

Determinations of age, sex, weight, diagnosis, drugs received, serum sodium, urinary creatinine concentration, and specific gravity were made for each patient. Weight, blood, and urine samples were obtained together in the early morning. Polyuria was considered present if the early morning urinary specific gravity was 1.008 or less.

Differences between group means were examined using unpaired $t$ statistics. Correlations among age, weight, serum sodium, urinary creatinine concentration, and specific gravity determinations were sought using the Pearson product-moment correlation coefficient. The frequencies of sex, polyuria, diagnoses, and drugs used among the various groups were compared with $\chi^2$ tests.

There were 15 unpaired $t$ statistics and 7 $\chi^2$ analyses performed on the same data base. We used the Bonferroni correction technique, which allows for changing the significance level by dividing the conventional level (.05) by the number of statistical operations used: the reader is invited to use a significance level of 0.003 for unpaired $t$ statistics and 0.007 for $\chi^2$ analysis.

**Results**

We performed $\chi^2$ tests initially to see if sex alone might predispose the patient to polyuria and thus vitiate further analysis. Using a $2 \times 2$ contingency table involving men and women and those patients with specific gravity (SPGR) $\leq$ 1.008 and SPGR $> 1.008$ (table 1), we found a $\chi^2$ of 0.41 ($p = 0.527$). These observations were further substantiated when we found the mean values for SPGR among men ($1.0116 \pm SD .0067$) and women ($1.0012 \pm SD .0057$) to be similar ($t = 1.002, p = .320$).

Male patients were younger than female patients ($t = 3.871, p = .000$) (table 1). Both serum sodium ($t = .845, p > .317$) and urinary creatinine concentrations ($t = 1.025, p = .309$) were similar among the men and women. Differences in weight between men and women did not quite approach statistical significance ($t = 2.117, p = .035$). Diagnoses were similarly distributed among men ($\chi^2 = 3.13, p = .208$) and women ($\chi^2 = 9.53, p = .049$) for patients with and without polyuria (table 1).

Among the men, the distribution of drugs was different ($\chi^2 = 11.39, p = .004$) for patients with and without polyuria. This difference disappeared ($\chi^2 = .89, p = .349$) when lithium was removed from the contingency table. For the women, there was no difference ($\chi^2 = 2.01, p = .367$) between those patients with and without polyuria. Comparing men and women, we found little difference ($\chi^2 = 5.88, p = .0519$) in the distribution of drugs. Since all patients were receiving antipsychotic drugs, this factor was not included in the above calculations.

Thirty-six percent of men and 45 percent of women were polyuric (early morning SPGR $\leq 1.008$). For men, SPGR ($t = 9.55, p = .000$) and urinary creatinine concentration (UCR) ($t = 6.955, p = .000$) differed between polyuric and nonpolyuric patients. This difference could not be accounted for by age ($t = 1.431, p = .153$), weight ($t = 1.105, p = .272$), or serum sodium ($t = .839, p > .317$) determinations. Also, for women, SPGR ($t = 7.243, p = .000$) and UCR ($t = 6.669, p = .000$) differed between polyuric and nonpolyuric patients. This difference could not be accounted for by age ($t = .429, p > .500$), weight ($t = 1.828, p = .075$), or serum sodium ($t = 1.494, p > .500$) determinations. Correlations among age, weight, serum sodium, UCR, and SPGR were sought among the polyuric and nonpolyuric men and women (table 1). The only consistent correlation was the relationship between UCR and SPGR ($r$ between .754 and .921, $p < .001$).

**Discussion**

Hyposthenuria is a semiquantitative index of polyuria, and early morning urinary specific gravities of 1.008 or less have been used to establish the presence of polyuria (Blum and Friedland 1983). Using this index of polyuria, we identified 26 of 72 male (36 percent) and 14 of 31 female (45 percent) institutionalized chronically psychotic patients as polyuric during a comprehensive survey of one of the chronic care units at a State mental hospital. Our prevalence is distinctly higher than that reported either by Jos and Perez-Cruet (1979) (6.6 percent) or Blum and Friedland (1983) (17.5 percent). Our observations approach Sleeper and Jellinek's (1936) finding that 55 percent of chronically psychotic patients are polyuric.

Factors including diagnosis, sex, age, weight, and serum sodium did not distinguish the polyuric from the nonpolyuric patients. For men, administration of lithium was associated with polyuria. This finding is consistent with the well-known fact that lithium may induce nephrogenic diabetes insipidus in up
Table 1. Values for sex, age, weight (kg), schizophrenic disorder (SZ), schizoaffective disorder (SA), organic mental disorder (OB), major depressive disorder (DP), bipolar disorder (BP), serum sodium (SOD) (mEq/l), urinary creatinine concentration (UCR) (mg/dl), urinary specific gravity (SPGR), antipsychotic drugs (AP), lithium (LI), carbamazepine (CARB), and phenytoin (PHY) for 103 institutionalized, chronically psychotic men and women evaluated for polyuria

<table>
<thead>
<tr>
<th>Polyuria Index</th>
<th>Subjects</th>
<th>Sex</th>
<th>Age</th>
<th>Weight</th>
<th>SOD</th>
<th>UCR</th>
<th>SPGR</th>
<th>AP</th>
<th>LI</th>
<th>CARB</th>
<th>PHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. SPGR &gt;1.008</td>
<td>46</td>
<td>M</td>
<td>39.1±</td>
<td>77.2±</td>
<td>27</td>
<td>16</td>
<td>0</td>
<td>138.9±</td>
<td>108.3±</td>
<td>1.0154±</td>
<td>46</td>
</tr>
<tr>
<td>B. SPGR &lt;1.008</td>
<td>26</td>
<td>M</td>
<td>35.0±</td>
<td>73.5±</td>
<td>20</td>
<td>4</td>
<td>0</td>
<td>139.6±</td>
<td>30.2±</td>
<td>1.0049±</td>
<td>26</td>
</tr>
<tr>
<td>C. All men</td>
<td>72</td>
<td>M</td>
<td>37.6±</td>
<td>75.8±</td>
<td>47</td>
<td>20</td>
<td>0</td>
<td>139.1±</td>
<td>80.1±</td>
<td>1.0116±</td>
<td>72</td>
</tr>
<tr>
<td>D. SPGR &gt;1.008</td>
<td>17</td>
<td>F</td>
<td>47.8±</td>
<td>73.4±</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>140.7±</td>
<td>98.1±</td>
<td>1.0143±</td>
<td>17</td>
</tr>
<tr>
<td>E. SPGR &lt;1.008</td>
<td>14</td>
<td>F</td>
<td>46.1±</td>
<td>65.4±</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>138.6±</td>
<td>31.6±</td>
<td>1.0053±</td>
<td>14</td>
</tr>
<tr>
<td>F. All women</td>
<td>31</td>
<td>F</td>
<td>47.0±</td>
<td>69.8±</td>
<td>22</td>
<td>3</td>
<td>3</td>
<td>139.8±</td>
<td>68.0±</td>
<td>1.0102±</td>
<td>31</td>
</tr>
</tbody>
</table>

Correlation matrixes

<table>
<thead>
<tr>
<th>A. Weight</th>
<th>SOD</th>
<th>UCR</th>
<th>SPGR</th>
<th>B. Weight</th>
<th>SOD</th>
<th>UCR</th>
<th>SPGR</th>
<th>C. Weight</th>
<th>SOD</th>
<th>UCR</th>
<th>SPGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.013</td>
<td>-0.199</td>
<td>-0.274</td>
<td>-0.020</td>
<td>Age</td>
<td>-0.209</td>
<td>0.122</td>
<td>0.105</td>
<td>0.185</td>
<td>Age</td>
<td>-0.015</td>
</tr>
<tr>
<td>Weight</td>
<td>0.008</td>
<td>0.122</td>
<td>0.162</td>
<td>-0.072</td>
<td>Weight</td>
<td>-0.072</td>
<td>0.183</td>
<td>0.102</td>
<td>Weight</td>
<td>-0.026</td>
<td>0.177</td>
</tr>
<tr>
<td>SOD</td>
<td>0.048</td>
<td>-0.004</td>
<td>UCR</td>
<td>0.800**</td>
<td>SOD</td>
<td>0.239</td>
<td>0.077</td>
<td>SOD</td>
<td>-0.014</td>
<td>UCR</td>
<td>0.884**</td>
</tr>
<tr>
<td>UCR</td>
<td>0.004</td>
<td>-0.004</td>
<td>SOD</td>
<td>0.239</td>
<td>UCR</td>
<td>0.754**</td>
<td>UCR</td>
<td>0.884**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where mean values appear ±1 standard deviation is recorded. For correlation matrices * = p < 0.05 and ** = p < 0.001.
to 20 percent of patients receiving this drug. Interestingly, lithium was not predictive in identifying polyuric patients among women.

Expectedly, the mean SPGR was lower among polyuric compared with nonpolyuric patients of both sexes. There was an excellent correlation between SPGR and UCR in this study, and one might choose UCR as an alternate index to separate polyuric from nonpolyuric patients. In Hoskins and Sleeper's study (1933) of polyuria among 57 male patients with schizophrenic disorders, the mean UCR was 49.55 mg/dl (actually creatinine nitrogen was reported, but this measurement can be converted to creatinine by multiplying creatinine nitrogen by 2.69 and then UCR obtained by dividing creatinine by urinary volume). This mean value of UCR of 49.55 mg/dl was associated with a mean daily urinary volume of 2,496 ± SD 1,707 ml. Using a method previously described by us (Vieweg et al. 1985a, 1985b), we found the mean daily urinary volume of our 26 male polyuric patients to be 3,935 ± SD 4,361 ml, compared to 2,987 ± SD 1,410 ml in our 14 female polyuric patients. Thus, our polyuric patients excreted larger volumes than those reported by Hoskins and Sleeper (1933). The difference may reflect the fact that Hoskins and Sleeper did not divide their population into polyuric and nonpolyuric patients. Jos and Perez-Cruet (1979) and Blum and Friedland (1983) did not report daily urinary volumes. The recent report by Lawson, Karson, and Bigelow (1985) appears to have underestimated daily urine volumes among psychotic patients.

The clinical implications of our findings remain unclear. Few of our patients manifested hyponatremia during this survey (although one patient had a serum sodium determination of 126 mEq/l). We did not perform a chart review, as did Jos and Perez-Cruet (1979), looking for any episodes of symptomatic hyponatremia during the course of the patients' hospitalization. However, on the basis of our own clinical experience and the experience recorded in the literature, a large number of institutionalized chronically psychotic patients appear to be at risk to suffer the complications of "water intoxication." We have suggested a simple method to identify those patients who may be at greatest risk. Further studies are indicated.

It appears to us that the disturbances in the limbic system associated with psychosis through anatomical and biochemical pathways bring about changes in the supraoptic and paraventricular nuclei of the hypothalamus where thirst and osmotic regulation take place. Presumably, in the absence of hyponatremia, our polydipsic patients have altered thirst regulation. When hyponatremia appears, there is likely superimposed osmotic dysregulation. These mechanisms have been reviewed by us in greater detail recently (Vieweg et al. 1985a).

References


Hoskins, R.G., and Sleeper, F.H. Organic functions in schizophrenia.

Archives of Neurology and Psychiatry. 30:123–140, 1933.


The Authors

W. Victor R. Vieweg, M.D., is Associate Professor, Joseph J. David, M.D., is Assistant Professor, Joseph L. Glick, M.D., is Assistant Professor, Mark D. Lawrence, M.D., is Assistant Professor, Joseph J. Yazel, M.D., is Associate Professor, and Wilford W. Spradlin, M.D., is Professor and Chairman, Department of Behavioral Medicine and Psychiatry, University of Virginia School of Medicine, Charlottesville, VA. Wilma T. Rowe, R.N., is Unit Director, Clinical Evaluation Unit, Western State Hospital, Staunton, VA. Randell T. Curnow, M.D., is Associate Professor, Department of Internal Medicine, University of Virginia School of Medicine, Charlottesville, VA.

Videotapes on Schizophrenia Available

The Video Center of the George Warren Brown School of Social Work, in cooperation with several community and mental health organizations, has produced four videotapes on the following topics relating to survival issues for chronically mentally ill persons and their families in the community.

Coping With a Chronically Mentally Ill Relative in the Community—The two videotapes on this topic were produced in cooperation with the Alliance for the Mentally Ill, St. Louis Chapter. Each videotape presents the experiences of a family which has had some success surviving the multiple problems arising from caring for a mentally ill relative in the community. The videotapes are intended for an audience of parents and relatives of chronically mentally ill persons who could benefit from a vicarious sharing of experiences with the families on the videotapes.

Psychosocial Rehabilitation: Two Agencies Based on the Fountain House Model—These two videotapes were produced in cooperation with the Missouri Department of Mental Health, Independence Center, and Places for People, St. Louis, MO. Each videotape presents a psychosocial rehabilitation agency from the point of view of its members. The tapes are intended for professional audiences as well as for families and mentally ill persons who could benefit from knowing what it's like to experience psychosocial rehabilitation "from the inside."

For more information about the rental or purchase of these videotapes, please contact: Dr. David Katz, Video Center, Box 1196, Washington University, St. Louis, MO 63130.