Case Report

Water Intoxication and Rhabdomyolysis

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A 44-year-old woman was admitted because of stupor. She had consumed 3 liters of water due to thirst after drinking alcohol. Laboratory findings on admission revealed marked hyponatremia (sodium: 115 mEq/l). She was diagnosed as having water intoxication. She recovered from her hyponatremia upon excretion of a large amount of hypotonic urine. Subsequently, however, her serum creatine phosphokinase was markedly elevated at 28,650 IU/l, and her serum myoglobin reached 2,760 ng/ml. The relationship between the occurrence of hyponatremia secondary to water intoxication and rhabdomyolysis was suggested.

Key words: Hyponatremia, Creatine phosphokinase, Myoglobinuria

Water intoxication was first reported by Weir et al (1) as the over-intake of water resulting in consciousness disorders or convulsions. Brain edema is probably the cause of the neurological disorders in water intoxication (2). Rhabdomyolysis has been recognized as a complication of water intoxication (3) and hyponatremia (4), but its occurrence is very rare (5). Five cases of water intoxication with an elevation of serum creatine phosphokinase (CPK) have been reported (3, 5–8). We report a patient with both severe hyponatremia secondary to water intoxication and rhabdomyolysis, and discuss the mechanisms of rhabdomyolysis in water intoxication and hyponatremia.

CASE REPORT

A 44-year-old housewife was admitted to the Department of Internal Medicine, Bokuto Metropolitan Hospital, on January 25, 1989, because of stupor. Although she seldom drank alcohol and had no history of drug abuse she drank heavily (Japanese rice wine, 900 ml) on the day before admission. The next day she had nausea, vomited several times and felt thirsty. She then decided to drink a lot of fluid to wash out the residual alcohol from her body. So she drank 3 liters of Oolong tea which contains 1.19 mEq/l of sodium. She became stuporous in the evening and was transported to the emergency room.

Her blood pressure on admission was 140/80 mmHg, pulse rate 88 per minute and body temperature 36.9°C. Neurological examination revealed a consciousness level of stupor, increased deep tendon reflexes in both legs, and positive nuchal rigidity. Her hematocrit was 38.1%, white cell count 5,300/μl with a normal differential, and platelet count 323,000/μl. The patient’s urine volume reached 4,200 ml with a specific gravity of 1,006 during the first 12 hours after admission. While no urinary protein was detected, microhematuria was found to be present. Laboratory data disclosed marked hyponatremia and hypochloremia with slightly decreased serum potassium (Table 1). Bicarbonate was 26.1 mEq/l with a pH of 7.5, serum osmolarity 245.5 mOsm/kg, urine osmolarity 269 mOsm/kg, and urinary sodium concentration 116 mEq/day. Antidiuretic hormone (ADH) was 2.0 pg/ml (0.3–4.2), plasma renin activity 0.1 ng/ml/h (0.1–2.0), aldosterone 6.7 ng/dl (<18) and thyroid function was normal. Other laboratory
values revealed blood urea nitrogen (BUN) to be 7 mg/dl, creatinine 0.7 mg/dl, glucose 118 mg/dl, uric acid 4.5 mg/dl, and lactate dehydrogenase (LDH) 664 IU/l. Glutamate oxaloacetate transaminase (GOT) was normal, but creatine phosphokinase (CPK) was slightly elevated (Table 1).

Lumbar puncture revealed clear fluid with a pressure of 130 mmH₂O containing 6/3 cells (L:N = 6:0), protein 33 mg/dl, glucose 60 mg/dl (blood glucose 120 mg/dl) and no bacteria. Both IgG and IgM subclass herpes simplex virus titers in cerebrospinal fluid were negative. Serum herpes simplex titers were not elevated in pair samples obtained at a two-week interval. Computed tomography (CT) of the brain on admission showed mild brain edema (Fig. 1, left).

The patient was given intravenous fluid containing 130 mEq/l of sodium at a rate of 80 ml/h and intravenous diazepam, 10 mg, twice, and haloperidol, 10 mg, once, because of restless and purposeless movements. No convulsions were noted. Her consciousness level returned to normal within 24 hours after admission. Serum sodium levels also normalized. Brain CT on the third hospital day showed no brain edema (Fig. 1, right). The CPK level, 95% of which was myogenic, however, rose gradually along with an increase in myoglobin and aldolase (Table 1). The patient did not complain of

<table>
<thead>
<tr>
<th>Jan. 25</th>
<th>27</th>
<th>28</th>
<th>Feb. 3</th>
<th>6</th>
</tr>
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<tbody>
<tr>
<td>Sodium (mEq/l)</td>
<td>115</td>
<td>137</td>
<td>137</td>
<td>140</td>
</tr>
<tr>
<td>Potassium (mEq/l)</td>
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<td>4.8</td>
<td>5.1</td>
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<tr>
<td>GOT (IU/l)</td>
<td>39</td>
<td>159</td>
<td>278</td>
<td>39</td>
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<td>CPK (IU/l)</td>
<td>478</td>
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<td>Myoglobin-serum (ng/ml)</td>
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<td>2,760</td>
<td>ND</td>
<td>96.6</td>
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<tr>
<td>Myoglobin-urine (ng/ml)</td>
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<td>ND</td>
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<td>Aldolase (U/l)</td>
<td>ND</td>
<td>ND</td>
<td>133.2</td>
<td>63.9</td>
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</table>

GOT: glutamate-oxaloacetate transaminase, CPK: creatine phosphokinase, ND: Not determined
muscle weakness, tenderness, or dark brown urine. With sufficient fluid replacement, renal function remained within the normal range, and serum CPK and myoglobin levels spontaneously returned to normal.

**DISCUSSION**

The etiology of the marked hyponatremia observed in the present patient appeared to be water intoxication due to excessive drinking of salt-free fluids. This patient whose serum ADH level was normal could not truly be diagnosed as having the syndrome of inappropriate secretion of antidiuretic hormone (SIADH). However, the patient seemed to be in an antidiuretic state in spite of the presence of hyponatremia, because urine osmolarity (269 mOsm/l) was greater than that in maximum urinary dilution in the kidney. Furthermore, the serum ADH concentration (2.0 pg/ml) should be within the normal range if the serum sodium concentration is normal, but the serum ADH concentration was distinctly high in the presence of hyponatremia. This phenomenon seemed to be due to the nausea itself or the vomiting-induced dehydration. The present patient showed a relative increase in serum ADH concentration induced by ADH secretion that was enhanced by nausea and vomiting. The accompanying antidiuretic state may have aggravated the hyponatremia or played a role in its prolongation. Hypopituitarism and adrenal insufficiency cannot be excluded, however, since ACTH and cortisol levels were not measured. Water intoxication can occur with beer consumption (9), but the present patient seldom drank beer. The explanation for her drinking such a large amount of water is that she became hypovolemic and thirsty due to vomiting and that she was attempting to wash out residual alcohol from her body.

Although acute water intoxication is usually seen in psychogenic disease with excessive water drinking (7, 10), it has recently been shown that several drugs, such as diuretics (11), chlorpropamide (12), vincristine (13) and carbamazepine (14), can induce it. The present patient had markedly high CPK levels subsequent to water intoxication. To our knowledge only five cases of high CPK levels associated with water intoxication have been reported (3, 5–8) (Table 2). These patients, including the present patient, were healthy people without any underlying disease and recovered completely. Four cases in the literature (5–8) had convulsions, however, no convulsions were observed in the present case. Creatine phosphokinase levels following convulsions have been reported to range between 300 and 1800 IU/l after 24–48 hours (15–17). Compared with these groups, CPK levels observed in water intoxication appear to be higher with peak levels after 48–96 hours.

The mechanism of the CPK elevation in chronic alcoholism has been suggested to be a direct toxic effect of alcohol on muscles (16, 18). Brain edema in water intoxication results from decreased serum osmolarity and the influx of water into the cells (2, 19). The elevated CPK, aldolase and myoglobin levels in water intoxication suggested rhabdomyolysis. Hyponatremia causes cell swelling due to the decreased osmolarity of the extracellular fluid. The cells return to normal size extruding intracellular fluid.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Convulsion</th>
<th>Sodium (mEq/l)</th>
<th>Potassium (mEq/l)</th>
<th>Peak CPK (IU/l)</th>
<th>Hospitalization day of peak CPK</th>
<th>Reference number</th>
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<tr>
<td>1</td>
<td>62</td>
<td>M</td>
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<td>116</td>
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<td>3</td>
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<td>M</td>
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<td>124</td>
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<tr>
<td>6</td>
<td>44</td>
<td>F</td>
<td>–</td>
<td>115</td>
<td>3.3</td>
<td>28,650</td>
<td>4</td>
<td>present case</td>
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</table>

CPK: creatine phosphokinase

**Table 2. Water intoxication and hyponatremia associated with high CPK.**
potassium, and then rhabdomyolysis occurs in the potassium-depleted muscles (4). It seems likely that the cause of the rhabdomyolysis observed in water intoxication and hyponatremia is multifactorial, including such factors as hypokalemia, exertion, and convulsions, administration of sedative drugs and temperature elevation (3). The possibility that hyponatremia was coincidentally associated with rhabdomyolysis cannot be denied.

CPK levels in water intoxication associated with marked hyponatremia should be determined. If elevated, adequate hydration with sodium supplements can protect against renal damage secondary to rhabdomyolysis (20).

REFERENCES