Case report

Cerebral swelling in severe hyponatremia caused by water intoxication in a schizophrenic patient

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Abstract

A 41-year-old female suffering from water intoxication showing consciousness disturbance with a serum sodium level of 104 mEq/l followed by repeated seizures is reported. She had been treated for 16 years with the drug, chlorpromazine. The computed tomography (CT) showed a bilateral hemispheric swelling. This swelling improved after spontaneous urination with an amount of 6700 ml within the first 12 h. We postulate that severe hyponatremia is possibly life-threatening, moreover, it is hardly recognized if the past history or previous prescription record was not known, because the CT appearance is sometimes misinterpreted.

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1. Introduction

Compulsive water drinking commonly occurs in the psychiatric patient \cite{1}. The cause has yet to be proven, however, the administration of anti-psychiatric drugs or the disease itself is considered to be responsible for polydipsia.

A case of water intoxication showing consciousness disturbance with a serum sodium level of 104 mEq/l followed by repeated seizures is reported. The computed tomographic images at the time of hyponatremia illustrate this most serious life-threatening condition.

2. Case report

2.1. Case report

A 41-year-old female had been complaining of general malaise and loss of appetite for several days. A family member had realized that she had taken lots of water frequently and also vomited many times for a period of 4 or 5 days. She visited a local physician where she was pointed out to suffer from dyspnea. On the same day a generalized seizure suddenly occurred and that forced her to be transferred to our institute on referral from the local physician.

2.2. General condition and neurological examination

At the time of arrival to our institute, the patient was semicomatose and her eye balls deviated to the right, however, the generalized seizure that struck her had vanished. The extremities showed a post-ictal flaccid palsy. Her initial vital signs were fairly stable, such as 130/86 mmHg blood pressure, and 102 bpm heart rate and 36.6 \textdegree C body temperature. Just after the computed tomography (CT) examination, the patient manifested a generalized seizure once again. Repeated injection of diazepam and a drip intravenous infusion of phenytoin could not relieve her seizure. The patient had a deteriorated respiration as well. Therefore, we intubated her and gave a continuous intravenous administration of the rapid acting barbiturate managed by a respirator.
2.3. Past history

The patient had been treated for about 16 years with anti-psychiatric drugs (chlorpromazine, promethazine and several kinds of minor tranquilizers such as diazepam) for the treatment of an extensive period of alcohol intoxication, insomnia, and displays of violent action against family members. She also had a history of bronchial asthma, an extensive period of cigarette smoking (two packs a day), and alcohol consumption (beer) of about 2.5 l in a day. She was admitted to a local hospital one and half years previously because of excess water drinking, however, at that time she had not become unconscious nor suffered from a seizure.

2.4. Course after hospitalization

Initial serum biochemistry at the time of admission revealed that her sodium level was markedly low at 104 mEq/l. Low values of hematocrit and blood urea nitrogen suggested the state of systemic overhydration. No other abnormality was seen and her renal function was satisfactory.

Urine in the amount of 6700 ml was spontaneously produced after admission to the ICU within the first 12 h. Ordinary electrolyte-fluid of 2000 ml was intravenously administered for 12 h and the serum sodium level became 121 mEq/l the next morning. Hypertonic saline solution or enteral administration of salt were never planned nor performed. During the next 24 h, though urine volume decreased, urine in the amount of 4050 ml was still being excreted. The daily profiles of urine volume and the water balance associated with the serum sodium levels were summarized in Fig. 1, which showed that the greatest amount of the urination occurred in the first two days. During this period, we did not give any diuretics, corticosteroids, mannitol or glycerol.

She had needed barbiturate administration for two days to control the seizure attack. Moderate elevation of serum creatinine phosphokinase was noticed at the peak level on the fifth day after admission, however, the evidence showing massive destruction of muscles such as myoglobinuria was not observed.

The initial CT scan on admission showed the disappearance of the whole cerebral cortical sulci which indicated the bilateral hemispheric swelling (Fig. 2a–c). This condition rapidly improved after a partial increment of the serum sodium level some 12 h later. However, some cortical sulci were still poorly visualized (Fig. 2d–f). CT appearance became completely normal after two days (Fig. 2g–i).

Further laboratory examinations revealed no apparent systemic infection, no elevation of tumour marker levels, normal vitamins B values, normal thyroid function, and no renin-angiotensin system disequilibrium shown in Table 1.

A week later, she had her barbiturate administration stopped and the respirator removed. Moreover, a further seizure never recurred. She gradually regained her consciousness. About one and half months later, she could

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**Fig. 1.** Daily profiles of urine volume (UV), water balance (WB), and serum sodium levels of first seven days of hospitalization. Marked amount of urine produced in the first two days and WB showed apparently negative values. As a result of this urination, serum sodium level normalized from 104 to 142 mEq/l.
begin to eat by herself and then had a simple restriction of water intake with 800 ml a day. She became fully ambulatory two months later and at this time the magnetic resonance imaging revealed no abnormality in both brain parenchyma and brain stem (Fig. 3). Hyponatremia never occurred in the next year with no major tranquilizer being administered.

3. Discussion

It is reported that the psychiatric patients suffer from polydipsia in about 6% of cases and is also reported some of these result in water intoxication in about 1% [1]. The cause of the polydipsia has yet to be proven, however, the disease itself or the administration of

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Fig. 2. Serial computed tomography of the case. Bilateral cerebral cortical sulci completely disappear (a, b, c), which indicates a marked cerebral swelling, without any other space-occupying lesion. This swelling was relieved (d, e, f) as the sodium level increased. Whole cortical sulci become completely visible (g, h, i) on the third day.
the anti-psychiatric drugs were considered to be a responsible factor [2]. Since water intoxication sometimes threatens the patients' life, the drug replacement which is expected to cause the lowered frequency of water intoxication or the other treatment such as the mineralized water intake were tried. Even so, the possibility exists to cause severe hyponatremia. The way of treatment is thought to be controversial [6]. The main feature of this condition is the excess reservation of the water in the body without any other medical abnormality. Some abnormalities concerned with water-handling factors might be associated in certain cases. However, the main course of treatment should be the restriction of the water intake. Forced urination or administration of hypertonic saline solution will bring about a rapid increase of the serum sodium level, however, that may prove to be harmful and not beneficial causing such as central pontine myelinolysis. Simple water intake restriction will bring about a spontaneous normalization of the serum sodium level. As improvement of the serum sodium level develops, the cerebral swelling becomes relieved rapidly. Relief was seen in the present case as long as hyponatremia has not been prolonged. However, acutely occurring hyponatremia will cause a severe degree of cerebral swelling, which rapidly results in the transtentorial herniation, especially in a young patient. If the sign of the herniation was recognized, acute reduction of intracranial pressure should be done using normal diuretics, or osmotic diuretics as quickly as possible.

Furthermore, a repeated measurement of the serum sodium levels is quite important. If the proper treatment is performed, the brain will not suffer from any damage as shown in the present case. Our case showed an excellent recovery by a simple regimen of water restriction, which was possible because the patient was unconscious and being administered barbiturates. Simple water restriction cannot always be performed because it is sometimes difficult for the patients to control the urge to drink water. However, even a minimum degree of water restriction will refrain from developing the severest hyponatremia after the patients have recovered.

We postulate that the severe degree of acute hyponatremia is life-threatening, moreover, CT appearance is sometimes misunderstood, as no abnormality, harbouring subarachnoid hemorrhage or meningitis can be determined. Knowledge of past medical history and drug use are also critical areas to understand in this type of case.

4. Summary

A case of water intoxication showing consciousness disturbance with a serum sodium level of 104 mEq/l

| Table 1 Summary of Laboratory data rather than routine examinations |
|-----------------|------------------|
| **June 12 (day of admission)** |                     |
| Ccr             | 88–161 (70–130 ml/min) |
| Ammonia         | 49 (70–150 µg/dl)    |
| HbA1c           | 3.7 (4.3–5.8%)      |
| Coagulofibrinolytic tests |               |
| INR             | 1.21               |
| FDP             | 2.3 (< 7 µg/ml)     |
| **June 13 Vitamins** |                  |
| V-B12           | 23 (20–50 ng/ml)    |
| V-B12           | 70.3 (66.1–111.4 ng/ml) |
| V-B12           | 1660 (210–1200 pg/ml) |
| Folate          | 8.6 (2.5–9.2 ng/ml)  |
| Thyroid hormones |                     |
| Free T3         | 2.8 (2.2–4.1 pg/ml)  |
| Free T4         | 0.8 (0.8–1.7 ng/dl)  |
| **Water-handling factors** |                |
| ADH             | 1.2 (0.5–3.5 pg/ml)  |
| ANP             | 17 (< 43.0 pg/ml)    |
| Aldosterone     | 20 (20–140 pg/dl)    |
| Cortisol        | 7.7 (5.3–24.5 µg/dl) |

ADH, antidiuretic hormone; ANP, atrial natriuretic peptide; Ccr, Creatinine clearance; FDP, fibrinogen and fibrin degradation products; HbA1c, glycosylated hemoglobin; INR, international normalized ratio of prothrombin time.
followed by repeated generalized seizures was reported. A 41-year-old female had been complaining of general malaise for a period of several days. She had frequently taken lots of water and also vomited many times for a period of 4 or 5 days. She had been treated for about 16 years with anti-psychiatric drugs (chlorpromazine, promethazine and several kinds of minor tranquilizers such as diazepam) for extensive periods of alcohol intoxication, insomnia, and displays of the violent action against family members. The initial CT scan on admission showed the whole cerebral cortical sulci in a disappeared state, which indicated the severe degree of the bilateral hemispheric swelling. This rapidly improved along with the normalization of the serum sodium level after spontaneous urination with an amount of 6700 ml within the first 12 h. The magnetic resonance imaging two months later revealed no abnormality in the brain parenchyma. Compulsive water drinking is known to commonly occur in psychiatric patients. The cause has yet to be proven, however, the administration of anti-psychiatric drugs or the disease itself is considered to be responsible. The severe degree of water intoxication showing apparent hyponatremia frequently causes repeated seizures and is thought to be possibly lethal. This indicates that if we have a patient experiencing a seizure, it is very important to ask whether the patient takes any anti-psychiatric drugs. Moreover, if the psychiatric patients has seizures, we should examine the serum sodium level questioning that they may suffer from hyponatremia. The principle treatment should be a

Fig. 3. Magnetic resonance images of the case taken two months later. There is no proof of cortical and brain stem lesions in both $T_2$-weighted images (a, b) and fluid attenuated inversion recovery images (c, d).
restriction of water intake. Since simple water intake restriction is most important, excess administration of sodium is not needed. Forced urination or administration of hypertonic saline solution will bring about a rapid increase of the serum sodium level, however, it may prove harmful. We should keep in mind that severe hyponatremia is possibly life-threatening and in this situation CT appearance is sometimes misinterpreted. To ask the patient or family about past medical history or previous prescription regimens is helpful to lead to a correct diagnosis.

References


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