

Hyponatremic Brain Edema: Correlation with Serial Computed Tomography Scans

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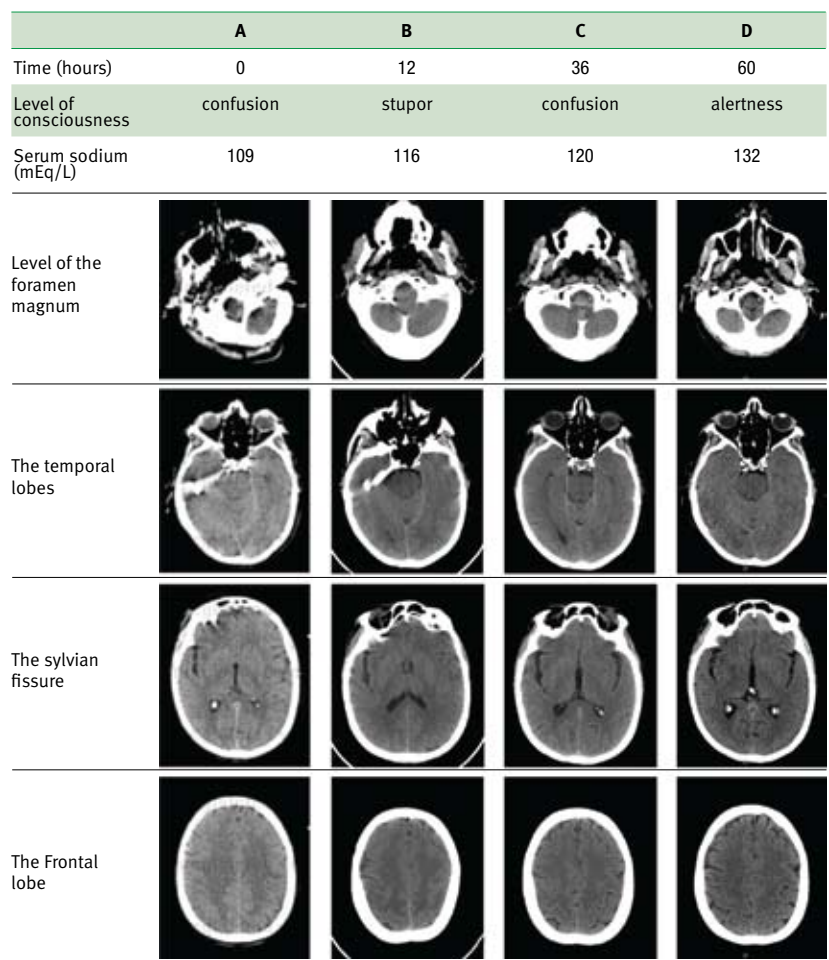
Hyponatremia, defined as a decrease in the serum sodium concentration to less than 136 mEq/L, is one of the most common electrolyte abnormalities among hospitalized patients [1]. Most hyponatremic patients are asymptomatic or have only mild symptoms such as headache, nausea, or vomiting. However, when this disorder develops rapidly, there can be severe life-threatening complications such as seizures and coma. Animal studies have suggested that the symptoms of hyponatremia, which are predominantly neurological, are related to changes in brain water and electrolyte levels [2]. However, there are only a few reports in the literature on the development and resolution of brain edema in clinical hyponatremia.

PATIENT DESCRIPTION

A 71 year old woman with depressive symptoms was admitted to a psychiatry department. She had not received any previous medical therapy. On physical examination on the day of admission her neurological examination was unremarkable.

Medical treatment with 10 mg paroxetine, a selective serotonin reuptake inhibitor, was started. On the second day, serum sodium was 133 mEq/L, similar

Figure. Course of level of consciousness, serum sodium level and brain CT findings in four consecutive scans [A-D]. The scans are not with identical angle due to slightly different head positions imposed by the patient. [A] On admission to the emergency department: Note the definite brain edema with near absence of cerebral sulci and compression of the ventricles and the sylvian fissures. The cerebral spinal fluid in the basal cisterns and in the cerebral sulci is diminished. [B] Signs of brain edema persist, without any improvement. [C] Signs of brain edema are diminished, with the appearance of the sulci around the frontal and parietal lobes. [D] Only mild brain edema is present.



to the 134 mEq/L level measured 7 days before admission. She received a second dose of 10 mg paroxetine and 6 hours

later complained of nausea and headache. On the morning of the third day the patient started to vomit, and a third

dose of 10 mg paroxetine was given. Four hours later, she became confused. On examination, blood pressure was 205/110 mmHg, and left gaze preference and a positive Babinski sign on the right side were observed. She was transferred to the emergency room where a brain computed tomography scan revealed severe brain edema [Figure A]. Serum sodium level at that time (time of diagnosis) was 109 mEq/L, a reduction of 24 mEq/L in only 26 hours. Serum potassium was 3.3 mEq/L, serum osmolality 230 mOsm/kg and serum urea 22 mg/dl. Hyponatremia-related brain edema was diagnosed, and the patient was treated in the emergency room with 120 ml of 3% NaCl hypertonic solution. Four hours later, serum sodium level did not improve and was only 108 mEq/L, and urine examination revealed a sodium concentration of 116 mEq/L. Thyroid-stimulating hormone level was 1.92 mIU/L (normal 0.5–5 mIU/L), cortisol 69 µg/dl (normal 7–23 µg/dl), serum urea 19 mg/dl, creatinine 0.6 mg/dl and uric acid 2.0 mg/dl. These findings established the diagnosis of the syndrome of inappropriate antidiuretic hormone secretion caused by treatment with an SSRI.

The patient was transferred to a medicine ward where the paroxetine treatment was discontinued. Because of her stupor she could not drink and was treated with 1 L of intravenous isotonic saline. Twelve hours after diagnosis there was no improvement in her neurological status. On examination, she was stuporous and responded to painful stimuli only; bilateral Babinski sign and mydriasis of the left pupil were found. However, serum sodium at that time rose to 116 mEq/L and urine sodium level decreased to 92 mEq/L. Despite the increase in sodium level, no alleviation of the severe brain edema was noted on repeated CT scan [Figure B].

One day after the diagnosis the patient was still unable to drink and an additional liter of isotonic saline was delivered intravenously continuously

at a rate of 40 ml/hour. At 36 hours after diagnosis, she was conscious but still confused. A third CT scan showed a decrease in the severity of the cerebral edema [Figure C]. Serum sodium was 120 mEq/L and urine sodium 12 mEq/L. From that point on, the patient was treated only with oral fluid restriction. At 60 hours after the diagnosis, the serum sodium level rose to 132 mEq/L, and a fourth CT scan revealed very mild signs of brain edema [Figure D]. All brain CT examinations were performed after considering the risk of radiation. Two weeks after diagnosis the serum sodium measured 141 mEq/L.

COMMENT

Brain edema is an integral part of severe symptomatic hyponatremia. Development of hypotonic hyponatremia results in water entry into brain cells and cellular swelling. Since the surrounding cranium limits brain expansion, intracranial pressure increases. The brain adapts to this condition within hours by excreting solutes, which leads to cellular water loss and a reduction in brain swelling [3]. However, when the hyponatremia develops rapidly the risk of brain edema is higher since the adaptive mechanisms are not fully developed. In the case reported here, there was a very rapid development of hyponatremia with a decrease in sodium plasma from 133 to 109 mEq/L in only 26 hours, resulting in brain edema. SSRI-induced hyponatremia has been reported widely. A recent review shows that most affected subjects were older than 65 years and developed hyponatremia within a median time of 13 days [4].

In a previous study on experimental hyponatremia in rabbits, the association between symptoms and changes in brain water and electrolytes was examined [2]. An increase in brain water had a major effect on the appearance of symptoms. The authors concluded that in hyponatremia, animal symptoms and morbidity are only grossly related to the magnitude of hyponatremia. The current case rep-

resents a similar observation in humans. Our patient's symptoms did not correlate perfectly with serum sodium level. Indeed, despite an improvement in sodium level, from 108 to 116 mEq/L, there was a clinical deterioration, with stupor and eye mydriasis. Clinical manifestations were better correlated with brain CT findings, which showed no amelioration of the severe brain edema. The reason for the lag period, the delayed response of brain edema to the rise in serum sodium, is not known and should be explored in future research. The use of brain imaging by CT or MRI was previously suggested by Gross et al. [5] in an attempt to distinguish between acute severe hyponatremia, which may be accompanied by brain edema and that requires rapid correction, and chronic severe hyponatremia in which brain edema is usually absent and that requires a slower rate of correction in order to avoid myelinolysis.

The symptoms in clinical hyponatremia, which are probably secondary to brain edema, may correlate better with brain CT findings than with the degree of hyponatremia. We suggest that in hyponatremic cases with a discrepancy between clinical status and severity of hyponatremia, brain CT scan may be beneficial.

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SSRI = selective serotonin reuptake inhibitor