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ISSN 2544-1361 (online); ISSN 2544-2406
doi: 10.15584/ejcem.2019.4.15

http://www.ejcem.ur.edu.pl/en/
European Journal of Clinical and Experimental Medicine
Eur J Clin Exp Med 2019; 17 (4): 371–377

CASUISTIC PAPER

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Osmotic demyelination syndrome in a patient with slowly equalized severe hyponatremia – a case report

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ABSTRACT

Introduction. Osmotic demyelination syndrome (ODS), or central pontine myelinolysis (CPM), is a complication of severe and prolonged hyponatremia, particularly when hyponatremia is corrected too rapidly. However, even slow correction of hyponatremia can result in ODS.

Aim. In this paper, we describe a patient who developed ODS following slow correction of hyponatremia.

Description of the case. This article describes a case of chronic hyponatremia occurring in the course of alcoholism. The patient was admitted in severe condition with extremely low sodium level. Electrolyte supplementation was carried out according to the European Renal Best Practice (ERBP) guidelines; however, there was a rapid increase in sodium level leading to the development of symptomatic osmotic demyelinating syndrome. Following several weeks of rehabilitation and supplementation of B vitamins, the patient's condition gradually improved.

Conclusion. Sodium deficiency should be equilibrated very carefully, especially in patients with chronic hyponatremia in the course of alcoholism. Even small doses of sodium administered in accordance with the guidelines in chronic hyponatremia can cause a rapid increase in serum sodium level resulting in osmotic demyelination syndrome.

Keywords. alcoholism, osmotic demyelination syndrome, sodium

Introduction

Osmotic demyelination syndrome (ODS) is a complication of severe and prolonged hyponatremia, particularly when treated with rapid correction. The pathogenesis of ODS is not completely understood. During chronic hyponatremia, osmotically active substances and water are lost from brain cell. These solutes cannot be replaced quickly enough with a rapid correction of the hyponatremia. The rapid shifts of intracellular, extracellular, and intravascular water, sodium, chloride, and organic osmolytes produce relative glial dehydration, myelin degradation, and/or oligodendroglial apoptosis.[1-3]

Demyelination typically occurs in areas of the brain that are the slowest to uptake osmolytes, which most commonly include the central pons (central pontine myelinolysis – CMP), but can be found in the cerebellum, lateral geniculate body, hippocampus, cerebral cortex, thalamus, caudate nucleus, internal capsule,

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Participation of co-authors: A – Author of the concept and objectives of paper; B – collection of data; C – implementation of research; D – elaborate, analysis and interpretation of data; E – statistical analysis; F – preparation of a manuscript; G – working out the literature; H – obtaining funds

Received: 27.02.2019 | Accepted: 3.11.2019
Publication date: December 2019

Rudnicka-Czerwiec J, Bartosik-Psujek H. *Osmotic demyelination syndrome in a patient with slowly equalized severe hyponatremia – a case report*. Eur J Clin Exp Med. 2019;17(4):371–377. doi: 10.15584/ejcem.2019.4.15

midbrain, and mammillary body as well.[4-6]

CPM occurs in 30%-50% of patients, demyelination of extrapontine sites only were found in 20%-50%, and both the central pons and an extrapontine area in 30%-50%.[4,7]

Comorbidities that are highly associated with incidence of CPM include dialysis, liver failure and transplantation, advanced lymphoma, carcinoma, cachexia, severe bacterial infections, acute hemorrhagic pancreatitis, chronic alcoholism, and pellagra.[8,9] The clinical presentation of CPM is heterogeneous, including confusion, quadriplegia, pseudobulbar palsy, and coma.[10]

Rapid correction of hyponatremia is a known risk factor for the development of ODS. However, even a slow correction of hyponatremia can result in ODS. In this paper, we describe a patient who, with a slow correction of hyponatremia, developed ODS.[11]

Description of the case

The 51-year-old female patient, who had not previously received treatment on account of chronic diseases with a history of alcoholism, was transported in an ambulance directly from home to the Emergency Department. The patient's daughter found her lying unconscious on the floor at her home. Based on the information provided by the family, the patient had been vomiting, had had diarrhea and had fallen several times in four days preceding the admission. Before that the patient had also consumed alcohol. The family reported that the patient had been temporarily confused, had spoken incomprehensibly, had gibbered and had been excessively sleepy.

Physical exam on admission revealed: body temperature of 37.4°C, blood pressure 160/100 mmHg, heart rate 80 BPM. The patient was in deep sleep, she only opened her eyes slowly when stimulated with pain, unable to maintain verbal contact. Symptoms were observed in the following areas: meningeal (neck rigidity up to 4 fingers, positive Kernig sign); cranial nerves (the eyeballs periodically turned towards left, the pupils slightly dilated); limbs (the patient defended herself symmetrically with two upper limbs when stimulated with pain, the muscle tonus slightly decreased in lower limbs, the deep reflexes were symmetrical and there were no abnormal signs).

Lab test performed at the Emergency Department revealed very low sodium level — Na 99 mmol/L with reference range of 136–146 mmol/L. Results of all lab tests performed on admission were presented in Table 1.

At the Emergency Department the patient received 150 mL of 3% of NaCl i.v. due to severe hyponatremia.

After 4 hours additional 500 mL of 0.9% NaCl with 1.5 g of KCl i.v. and 2 g of $MgSO_4$ i.v. were administered.

A CT scan of the head was performed (Fig.1). Lumbar puncture was abandoned due to brain edema. The patient was admitted to the Department of Neurology.

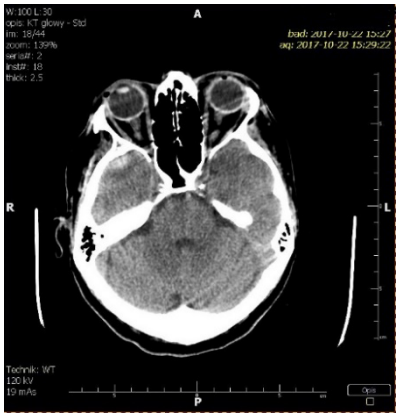

Fig. 1. A CT scan of the patient's head

At the base of the right temporal region, there is a hyperdense pericerebral hematoma measuring 15 × 7 mm in the plane of the scan. Furthermore, in this region there is a small hyperdense intracerebral hematoma surrounded by a region of edema. There is a small hypodense region in the right cerebellar hemisphere. There is a minor swelling of both cerebral hemispheres.

At the Department, according to the recommendations of a consulting specialist in internal diseases, another 150 mL of 3% NaCl i.v. were administered. During the first two days of hospitalization frequent electrolyte tests were performed. Changes in electrolyte levels were presented in Fig. 2.

In the following days, the patient's condition im-

Table 1. Laboratory tests results at the day of admission

ethanol	-		
blood count	WBC: 13,58*10^3/mcl (4,00-11,00*10^3/mcl) RBC: 4,29*10^6/mcl (4,2-5,4*10^6/mcl) Hgb: 14,2 g/dl (12,0-16,0 g/dl) PLT: 314*10^3/mcl (150-400*10^3/mcl)	acid-base balance	pH: 7,51 (7,35-7,43) pCO2: 15,0 mmHg (45-50 mmHg) pO2: 64,0 mmHg (33,0-53,0 mmHg) HCO3-: 20,7 mmol/l (22,0-26,0 mmol/l)
electrolites	Na: 99 mmol/l (136-146 mmol/l) K: 3,9 mmol/l (3,5-5,1 mmol/l) Cl: 67 mmol/l (101-109 mmol/l)	alanin aminotransferase	67 U/L (0,00-35,0 U/L)
urea	10 mg/dl (17-43 mmol/l)	aspartate aminotransferase	86 U/L (0,00-35,0 U/L)
creatinine	0,32 mg/dl (0,55-1,02 mg/dl)	CRP	23,5 mg/l (0-5 mg/l)

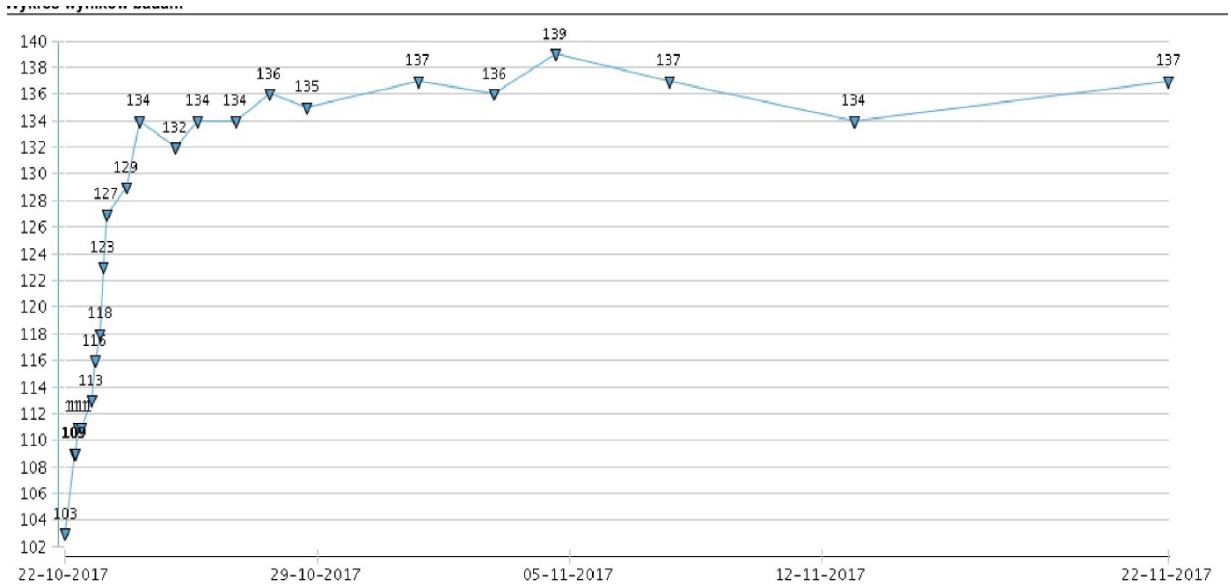

Fig. 2. Changes in the patient's blood sodium during hospitalization

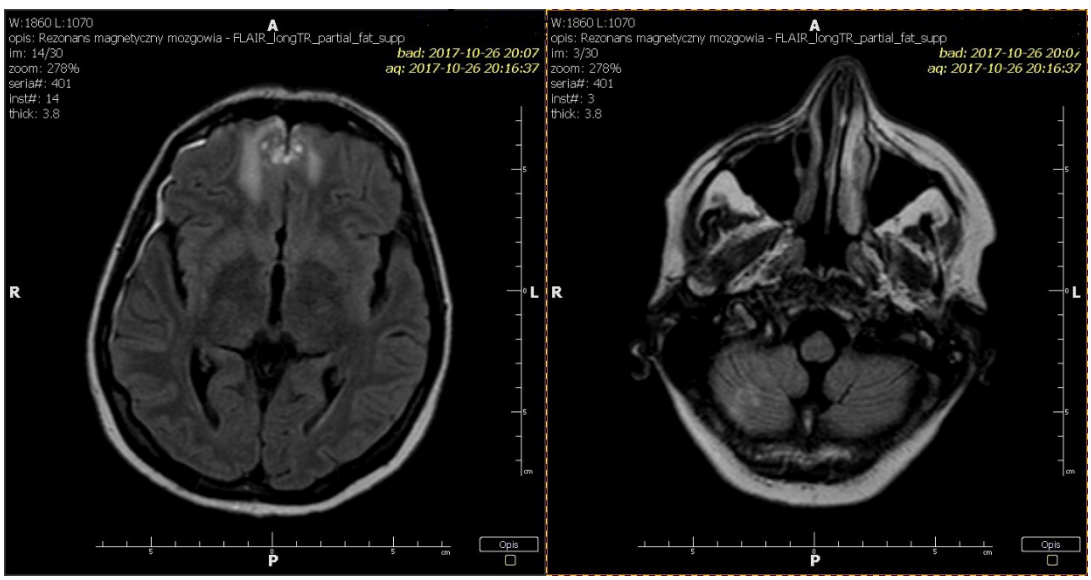

Fig. 3. A MRI of the patient's brain

proved. She was conscious, well oriented and able to walk without assistance. The patient denied alcohol abuse. She was also able to maintain a basic verbal contact and spoke consistently. However, the patient processed information more slowly and showed a decreased flexibility of thinking. Neuropsychological exam revealed cognitive deficits in short-term memory with preserved long-term and autobiographic memory. In addition, the patient had difficulties in executive, as well as visual and three-dimensional performance. Regarding abstract thinking, the patient presented the tendency to concretize. Understanding, praxis and visual gnosis of objects were all preserved.

The patient received dexamethasone, mannitol, ceftriaxone and probiotic - lacidofil.

A MRI of the brain was performed 4 days after the admission (Fig. 3).

On the right side, in the frontal, temporal and parietal region there is a cerebral hemorrhage. There are regions of brain contusion with evolving hematomas within them, in the right temporal region and adjacent parts of frontal lobes, located parasagittal, surrounded by a region of minor edema. In the right cerebellar hemisphere, there are ill-limited foci of increased signal in FLAIR and T2-weighted images, with contrast enhancement – blood-brain barrier damage within the foci of brain contusion.

In order to follow up the post-traumatic changes, according to the indications of a neurosurgeon, a CT scan of the head was performed 6 days after the admission. The imaging revealed regression of hematomas (Fig. 4).

On the tenth day of hospitalization the patient's condition deteriorated. She was conscious, drowsy, unable to

maintain verbal contact or to follow instructions. A neurological examination revealed: an increased muscular tension on the left side, deep reflexes more pronounced on the left side, lack of plantar reflexes, positive Babinski's sign on the left side. Meningeal symptoms were negative.

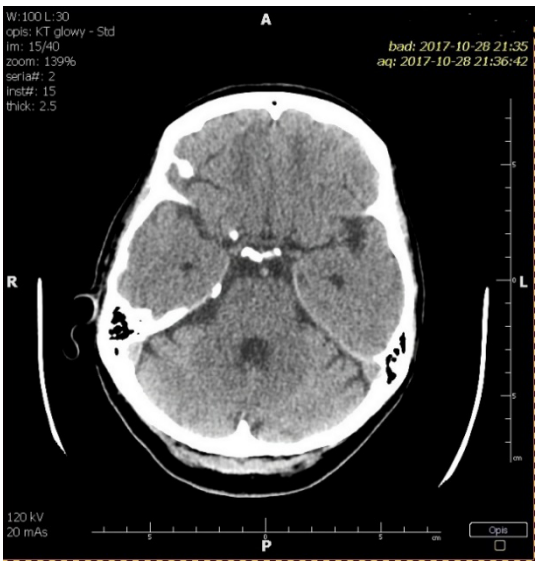

Fig. 4. Regression of hematomas. At the base of the frontal regions, bilaterally there are irregular regions of poorly decreased density – probably post-contusion. There is a similar, small focus in the right temporal lobe

An urgently performed CT scan of the head revealed no progression of post-traumatic changes or new abnormal foci (Fig. 5).

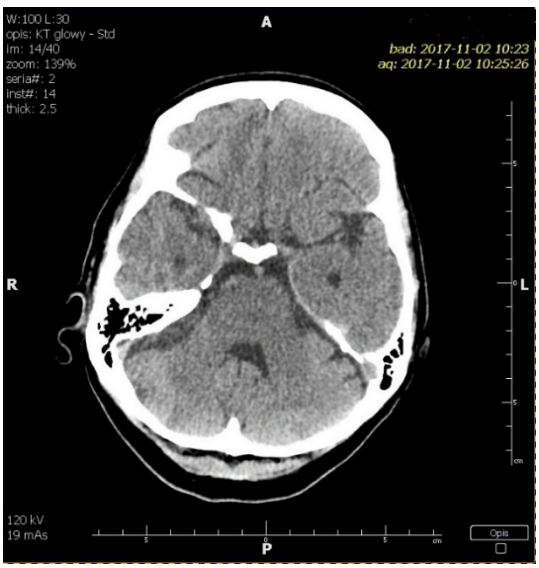

Fig. 5. There is no acute blood visible intracranially. At the base of the frontal regions, bilaterally there are irregular regions of poorly decreased density – probably post-contusion. There is a similar, small focus in the right temporal lobe and peripherally in the right cerebellar hemisphere

An EEG revealed a slowed basic activity.

Osmotic demyelination syndrome was suspected. Brain MRI confirmed the diagnosis and pontine and extrapontine demyelination was found. (Fig. 6).

Low molecular weight heparin was administered in order to prevent thromboembolism. The patient also received vitamin B1 and B12. Physical and cognitive rehabilitation was administered. After two weeks of treatment the patient was able to maintain logical verbal contact, was fully autopsychologically oriented and partially allopsychologically oriented. She was emotionally vulnerable, tend to cry and she was able to understand incoming information and execute instructions. Generalized psychological deficits were observed – psychomotor and verbal slowdown, spontaneity of action, prolonged reaction time, fatigability, attention deficits, disturbances of short-term memory and conceptual thinking.

The neurological examination revealed: negative meningeal symptoms; for cranial nerves: asymmetric grin on the left side; for limbs: minor weakening of the left limbs, no plantar reflexes, no abnormal signs, assisted gait.

The patient was transferred to the Department of Rehabilitation. in order to improve her performance and she stayed there for four weeks.

After three months control exam was performed. The patient was slightly distracted regarding orientation in time and space. The orientation regarding herself was preserved. Logical contact was preserved; she responded adequately to questions, her activity was slightly increased and her affect – elevated. There were no visible abnormalities in perception and content of thoughts. The course of thinking was slightly slowed. The patient maintained criticism regarding her health condition, but denied alcohol abuse. She presented deficit in lingual skills and verbal fluency, as well as difficulties in concentration. The patient exhibited memory disorders, especially regarding delayed rendering, perception and memorizing new information. The neurological examination revealed asymmetric grin on the left side, minor weakening of the left limbs, no plantar reflexes, no abnormal signs and normal gait.

A further MRI revealed regression of demyelination changes (Fig. 7).

At present the patient continues to improve her mobility and cognitive functions participating in environmental rehabilitation.

Discussion

The European Renal Best Practice (ERBP) of 2014 regarding treatment of hyponatremia with severe symptoms recommend that a 3% solution of NaCl i.v. should be administered immediately at the dose of 150ml within 20 minutes. This should be repeated until the sodium

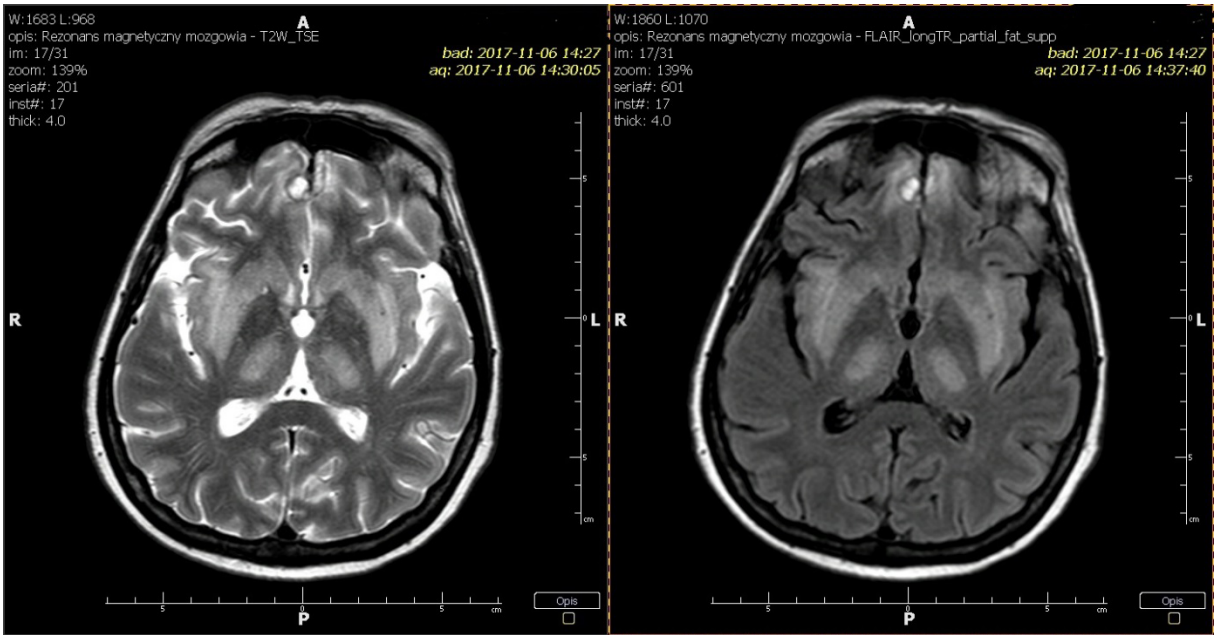

Fig. 6. There are regions of increased signal in T2-weighted images and sequences SEQ Flair bilaterally in the subcortical nuclei, in thalami, centrally in the pons and there are smaller foci in the subcortical white matter of both hemispheres – most likely resembling acute osmotic demyelination

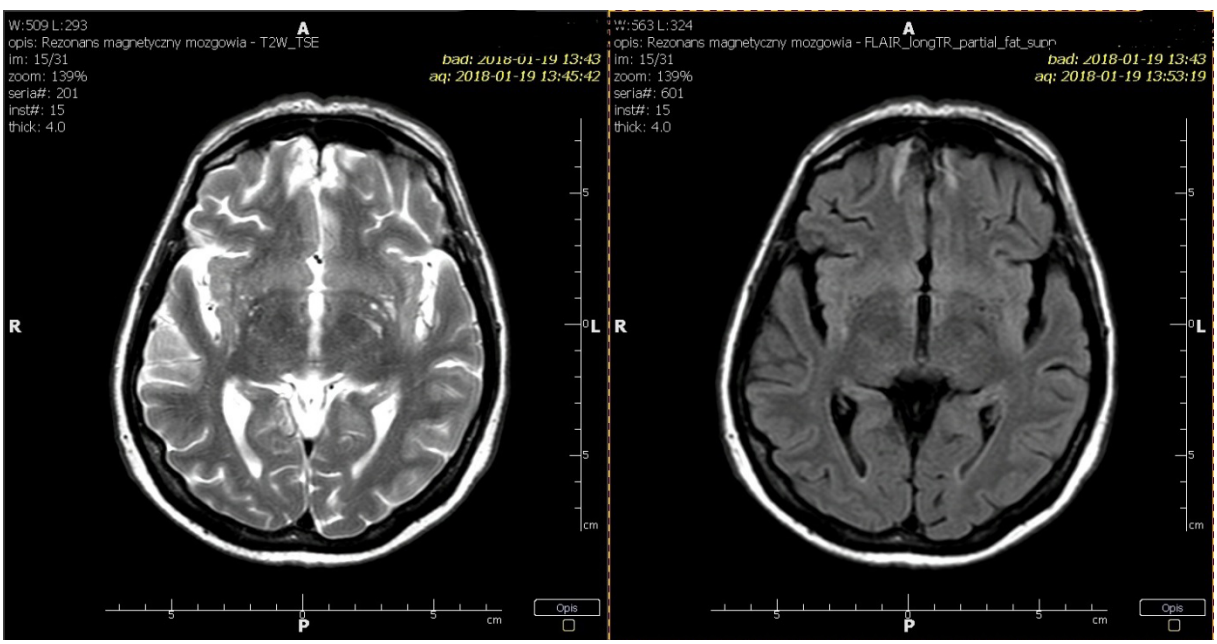

Fig. 7. The size of the foci and regions of demyelination within the basal nuclei and the pons decreased. Signs of edema relieved. There is mostly malacia surrounded by bands of astrocytic gliosis

level has increased by 5 mmol/L and the clinical condition has improved. Then, it is indicated to perform a slow infusion of 0.9 % NaCl i.v. until administration of casual treatment. An increase in sodium level in the first 24 hours must not exceed 10 mmo/L, and in the following days – 8 mmol/L. In cases of an increased risk of acute osmotic demyelination, as in the alcoholic patient described above, the increase in sodium level within the first 24 hours of supplementation should not exceed 8 mmol/L.[12]

In the presented case, the level of sodium was increased too rapidly, despite following the guidelines. On the first day of treatment, the sodium concentration increased by 10 mmol/L, and on the second – by as much as 16 mmol/ L, which is twice as high as the recommended and safe level.

The osmotic demyelination syndrome is considered to be an iatrogenic condition, caused by a too rapid administration of sodium in treatment of hyponatremia.[13] Chronic hyponatremia often occurs in patients

with alcoholism, especially in those abusing beer. This syndrome is called beer potomania.[14] It is described as the excessive intake of alcohol, particularly beer, together with poor dietary solute intake that leads to fatigue, dizziness, and muscular weakness.[15] In a literature review by Sanghvi et al., 18% of patients with beer potomania developed osmotic demyelination syndrome.[16] Beer potomania patients have a long-term history of beer intake, as well as a poor diet. Beer has trace amounts of sodium and almost negligible protein content. In addition, beer has calories that prevent muscular proteolysis, resulting in a dramatic decrease in urea generation. Thus, these patients have a very low osmolar load since dietary protein breakdown is the main component of osmolar load, in addition to small amounts from sodium and potassium. The presence of inadequate solute in the kidneys eventually causes dilutional hyponatremia, secondary to reduced clearance of excess fluid from the body.[17-19]

The described patient denied alcohol dependence. However, based on the information provided by the close family, she had been abusing alcohol, mostly beer, for several months. Therefore, the patient had supposedly had hyponatremia for a long time, which led to symptoms observed by the family such as drowsiness, irritability, muscle twitching, nausea and vomiting.

Alcoholism is a predisposing factor for osmotic demyelination syndrome not only because of co-existing low sodium levels. Feng et al. described the case of a patient who had been abusing alcohol for two months. She developed neuropsychiatric symptoms including drowsiness, tremors, as well as visual and auditory hallucinations. Blood tests showed no abnormality in electrolyte levels. An MRI scan showed changes characteristic of the osmotic demyelination syndrome. Treatment involved supplementation with vitamins B1 and B12, which resulted in significant clinical improvement.[20]

After the onset of osmotic demyelination symptoms, vitamins B1 and B12 were administered in an appropriate dosage. After three months of vitamin supplementation and rehabilitation, the patient's condition improved and the abnormalities in magnetic resonance imaging decreased.

Conclusion

This article presents a case of chronic hyponatremia in the course of alcoholism. The patient was admitted in a severe condition with extremely low sodium levels. Electrolyte supplementation was performed according to the ERBP guidelines; however, there was a rapid increase in sodium serum level leading to the development of symptomatic osmotic demyelinating syndrome. Following several weeks of rehabilitation and supplementation of B vitamins, the patient's condition gradually improved.

Sodium deficiency should be equilibrated very carefully, especially in patients with chronic hyponatremia in the course of alcoholism. It should be noted that even a small dose of sodium administered in accordance with the guidelines in chronic hyponatremia may cause a rapid increase in sodium level leading to osmotic demyelination syndrome.

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