Forensic Science International 220 (2012) 1–5

Contents lists available at SciVerse ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Review article

Forensic aspects of water intoxication: Four case reports and review of relevant literature

Nemanja Radojevic [a,*], Bojana Bjelogrlic [b,1], Vuk Aleksic [b,2], Nemanja Rancic [c,3], Mira Samardzic [d,4], Stojan Petkovic [e,5], Slobodan Savic [b,6]

[a] Department of Forensic Medicine, Clinical Centre of Montenegro, Podgorica, Montenegro
[b] Institute of Forensic Medicine, "Milovan Milovanovic", School of Medicine Belgrade, University of Belgrade, Serbia
[c] Medical Faculty, University of Kragujevac, Serbia
[d] Department for Endocrinology and Diabetes, Institute for Sick Children, Podgorica, Montenegro
[e] Department of Forensic Medicine, Clinical Center of Vojvodina, Novi Sad, Serbia

ARTICLE INFO

Article history:
Received 22 December 2011
Received in revised form 10 January 2012
Accepted 12 January 2012
Available online 4 February 2012

Keywords:
Water intoxication
Hyperhydration
Schizophrenia
Polydipsia
Polyuria
Child abuse
Ecstasy

ABSTRACT

Water intoxication (WI) is a rare condition that originates from over-consumption of water, with a potentially fatal outcome. Increased water intake (polydipsia) is followed by urination of high amount of diluted urine (polyuria) which are the main initial symptoms of WI. We present four case reports of WI. Two of them are unusual pediatric clinical cases using medical documentation and police case files, one of which is related to child abuse, and the other to a psychiatric disorder. The other two cases are fatal adult cases submitted to autopsy from a psychiatric hospital. Also, we present a diagnostic algorithm for polydipsia and polyuria before death. WI is usually seen in patients with psychiatric disorders, victims of child abuse or torture, drug abusers or it can be iatrogenically induced.

Contents

* Corresponding author at: Department of Forensic Medicine, Clinical Centre of Montenegro, Ljubljanska 1, 20000 Podgorica, Montenegro. Fax: +382 32 674 590; mobile: +382 69 340 510.
E-mail addresses: com_nr@yahoo.com (N. Radojevic), bojanabjelogrlic@gmail.com (B. Bjelogrlic), ner.vuk@hotmail.com (V. Aleksic), nece84@hotmail.com (N. Rancic), samardzic@t-com.me (M. Samardzic), pstojan@eunet.rs (S. Petkovic), savkenzi@gmail.com (S. Savic).
[1] Institute of Forensic Medicine, "Milovan Milovanovic", School of Medicine, University of Belgrade, Deligradska 31a, 11000 Belgrade, Serbia. Tel.: +381 63 8989 155.
[2] School of Medicine, University of Belgrade, Deligradska 31a, 11000 Belgrade, Serbia. Tel.: +381 11 2682 522.
[3] Present address: Susedgradska 41a/5, 11090 Belgrade, Serbia. Tel.: +381 63 8524 443.
[4] Department for Endocrinology and Diabetes, Institute of Sick Children, Medical Faculty, University of Montenegro, Ljubljanska 1, 20000 Podgorica, Montenegro. Tel.: +382 67 548 861.
[5] Department of Forensic Medicine, Clinical Centre of Vojvodina, Medical Faculty, University of Novi Sad, Hajduk Veljkova 1-7, 21000 Novi Sad, Serbia. Tel.: +381 21 454 927.
[6] Institute of Forensic Medicine, "Milovan Milovanovic", School of Medicine, University of Belgrade, Deligradska 31a, 11000 Belgrade, Serbia. Tel.: +381 11 2682 522.

0379-0738/$ – see front matter © 2012 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.forsciint.2012.01.021

1. Introduction

Changes in osmotic gradient in blood, extracellular and cellular compartment due to increased loss, increased intake or retention of water in the body, followed by saline imbalance, causes the maldistribution of water among these compartments and general disorder in water metabolism. Hormone regulation of water metabolism includes vasopressin (ADH, antidiuretic hormone which increases the reabsorption of water from the renal tubules), aldosterone (which reabsorbs sodium and excretes potassium in the kidneys) and a group of natriuretic hormones (which excrete sodium and water).

Water intoxication (WI), hyperhydration or water poisoning, is a rare condition that originates from overconsumption of water, with a potentially fatal outcome. This primarily affects the brain function. Increased water intake (polydipsia) is followed by urination of high amount of diluted urine (polyuria) which are the main initial symptoms of WI.

2. Methods

We evaluate two unusual pediatric clinical cases of WI (polydipsia & polyuria) using medical documentation and police case files, and two fatal adult cases subjected to autopsy.

3. Case reports

3.1. Case 1

A 5-year-old boy (112 cm, 22.5 kg) was admitted to a pediatric hospital due to strong thirst, excessive water intake (ca. 6 L a day) and frequent urination. The problems lasted for 10 days. He was the eldest child of the family, and was born 15 days premature. He had suffered from frequent bouts of bronchitis and atopic dermatitis, and two years previously he had infective mononucleosis. His mother had contact dermatitis to some metals and his grandfather had suffered from diabetes mellitus type II. On admission to the hospital, his blood pressure was 120/80 mmHg. Lab tests of his blood and urine (glucose, proteins, blood sedimentation, fibrinogen, cholesterol, triglycerides, urea, creatinine, uric acid, potassium, sodium and calcium) eliminated diabetes mellitus, hyperaldosteronism (Conn's syndrome), diuretic drugs abuse and polyuric phase of chronic renal failure. The osmolarity of urine was 85 mosm/L and the osmolarity of plasma was 285 mosm/L, which was the indication for the "thirst test" (6 h of water deprivation). If the test showed the inability of the kidneys to concentrate urine (<300 mosm/L, followed by plasma osmolarity >290 mosm/L), then diabetes insipidus (DI) might have been the diagnosis. On the contrary, the boy's results were 591 mosm/L (urine) and 332 mosm/L (plasma), and referred to psychogenic polydipsia. Following the diagnosis, the boy's parents talked about a stressogenic situation one year previously, when the household water supply system failed and the boy was very thirsty for half an hour. The psychological examination showed that the provoking factor for excessive water intake was jealousy of his new born brother that manifested itself through the emergence of previous stressogenic sensations.

3.2. Case 2

Some children played in the garden on a hot summer afternoon. After a 6-year-old boy returned home he kept asking his mother for a glass of water. This interupted the mother who was ironing and she became irritated and frustrated to the extent that she eventually placed a hosepipe into the boy's mouth and turned the water on while firmly holding his head. The boy's friend, who was watching the scene, ran to his house to tell his parents, who immediately called the police and the emergency service. On arrival at the house the authorities found the boy unconscious, with froth emitting his mouth and nostrils. The rapid aspiration of fluid from his airways and resuscitation saved the boy's life. In the hospital, 1900 mL of water was evacuated from his stomach. His blood pressure was normal, while the levels of electrolytes showed light hypotonic hyperhydration (blood dilution: Na^{2+} = 128 mequiv./L, K^{+} = 3.5 mequiv./L), so a single dose of furosemide was given. Diuresis in following 3 h was 1400 mL. The short period of oxygen deprivation did not have any effect on the boy's brain. Aspiration pneumonia was prevented by antibiotics. The boy's mother was admitted to a psychiatric hospital, where she was diagnosed with schizophrenia. The case was considered as child abuse and the boy was taken from his mother's care.

3.3. Case 3

According to information provided by his family, a 38 year old man suffered from schizophrenia with occasional compulsory intake of copious amounts of water. When he was found dead in his flat, he was lying on the floor next to the sink with the water tap running.

The findings of an autopsy carried out about 12 h after his death found: obesity (body weight 120 kg, height 185 cm), general congestion, brain edema (1770 g), tongue muscle hemorrhages, lung edema and emphysema, serosal petechiae, superficial mucosal laceration in the region of gastroesophageal junction, cca 1000 mL of urine in the urinary bladder and fat liver. The postmortem toxicological analysis was negative to ethanol and drugs in the blood and urine, while 15.5 mmol/L of potassium and 112 mmol/L of sodium were found in the vitreal humor.

3.4. Case 4

The medical record of a 40-year-old man who had been diagnosed with schizophrenia for 14 years showed that he had experienced polydipsia, nausea and vomitus for the first time one year prior to his death. According to the medical staff that provided psychiatric treatment, he was frequently observed drinking an excessive amount of water. His doctor reported that on three occasions he vomited large amounts of clear water, but examinations over the following two weeks showed normal findings. In his following stay at the hospital, his health condition progressively worsened, with weight loss and continuous drinking of extremely large quantities of water which was followed by occasional vomiting. He was pale, adynamic and unable to speak but he was able to write that he was drinking large amounts of water. The following year, he was admitted to the emergency room with a disturbance of consciousness (absance type) and he urinated without control. A laboratory examination showed low blood levels of sodium of 98 mmol/L and potassium of 2.6 mmol/L. Despite all the therapeutic and resuscitating measures taken, he died 4 h after admission. An autopsy was carried out to determine the cause of death.

The brain was edematous (1370 g), but there were no signs of herniation. The lower part of the esophagus had vertical scissions, possibly due to excessive vomiting. The lungs were also edematous and weighed 800 g and 850 g. The heart weighed 420 g, and right ventricle was hypertrophic. Coronary arteries showed sparse atherosclerosis. The stomach was extremely dilated (measuring 37 cm × 18 cm) with 1400 ccm of brownish fluid with some small parts of undigested food. Small adenomas of the adrenal cortex were found. Other organs showed no remarkable pathological changes. Histopathological analysis showed congestion and marked interstitial edema of all examined organs (mainly brain