

WATER INTOXICATION AND CHILD ABUSE

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Contribution to Emergency Nursing Practice:

- Forced water intake with subsequent hyponatremia is a potentially fatal form of child abuse.
- Health care workers should consider forced water intoxication in the differential diagnosis of otherwise unexplained hyponatremia.
- Hyponatremic encephalopathy can usually be reversed if proper treatment is initiated promptly.

Background

PROBLEM

Forced water intake with subsequent hyponatremia is an infrequent but potentially fatal form of child abuse. Emergency personnel are often the first providers to come into contact with victims of abuse; as such, they should consider forced water intoxication as a potential cause of hyponatremia with its associated neurologic symptoms when no other cause of hyponatremia is apparent. Fortunately, if detected early, the condition can usually be treated successfully; however, precious time may be lost in making the diagnosis in the emergency department, as perpetrators of the abuse are frequently reluctant to report the child's excessive water intake. The purpose of this article is to increase awareness of this rare but potentially lethal form of child abuse by describing 8 published cases of hyponatremia in children due to forced water intake.¹⁻⁶

DEFINITION OF WATER INTOXICATION

Water intoxication is a term used to describe hyponatremia caused by excessive water intake, either by forced drinking, improper dilution of infant formula, overloading with hypotonic intravenous fluids, or voluntarily drinking an excess of water (as in psychogenic polydipsia). When water

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intake exceeds renal excretion, dilution of the serum sodium level occurs. A below-normal sodium concentration in the bloodstream generates an osmotic gradient between the brain cells and the serum, causing water to shift into the brain cells, resulting in cerebral edema. The swollen brain's ability to expand is limited by the bony cranium; compared with adults or the elderly, this is especially problematic in young children owing to their comparatively high brain-to-skull size ratio.

The specific serum sodium concentration at which neurologic symptoms occur in children with hyponatremia is variable; clearly, symptoms are worse when the condition is brought on rapidly (as in excessive forced water intake over a short period). Also, severity of symptoms increases as the serum sodium level decreases. Early symptoms of hyponatremia may include nausea, vomiting, diarrhea, headache, lethargy, and blurred vision; if not treated, the condition may progress to confusion, seizures, coma, and death. Risk of seizure increases when serum sodium levels fall rapidly below 125 mEq/L (as in excessive forced water intake).⁴ Respiratory failure can occur suddenly in hyponatremic patients and is associated with encephalopathy.⁷

TREATMENT FOR WATER INTOXICATION

For mild hyponatremia without neurologic symptoms, oral and intravenous fluid restriction may be sufficient to cause a rise in the serum sodium concentration. However, the definitive treatment for hyponatremic encephalopathy is 3% NaCl (which contains 513 mEq of Na per liter); a dosage of 2 mL/kg of 3% NaCl over a period of 10 minutes (maximum of 100 mL) is recommended by Moritz and Ayus.⁸ Repeating the bolus 1 to 2 times may be needed until symptoms have improved. Further treatment with 3% NaCl is stopped when the patient is either symptom free (awake, alert, and free of headache and nausea) or an acute rise of 10 mEq/L has occurred in the first 5 hours.⁸ Correction of the hyponatremia should not exceed 15 to 20 mEq/L in the first 48 hours.⁸ The goal is for the patient to become alert and seizure free without elevating the concentration so quickly that osmotic demyelination occurs. This potentially irreversible type of brain damage is a condition characterized by severe injury to the myelin sheath of nerve cells in the brain, caused by a rapid change in plasma tonicity.

Method for Identification of Case Reports

Using the following key words (*hyponatremia*, *water intoxication*, and *child abuse*), a literature search was conducted using MEDLINE, PubMed, SCOPUS, and

TABLE

Summary of 8 case reports of documented forced water intake as a form of child abuse (1980–2013)

Author	Case No. Age Gender	Forced Water Intake Method	Serum Na Level	Symptoms	Other Abuses	Treatment and Outcomes
Mortimer, 1980 ¹	No. 1 4.5 y Male	Child said his foster father inserted a hose in his mouth and forced him to drink.	117 mEq/L	Emesis Diarrheal stool Shortly afterward, deep coma with facial twitching and generalized rigidity. Plain film of abdomen showed considerable gastric distention.	Right arm in cast for a 2-week-old fracture. Bruises on left temporal region and on thighs and buttocks.	Treated with diazepam, re-warming, and water restriction. Pronounced diuresis of dilute urine ensued. Regained consciousness within 8 hours; made complete recovery. Reason for hyponatremia still undetermined at time of discharge. Child eventually stated that he had not drunk the water voluntarily. Foster father was convicted of assault against the child.
Tilelli & Ophoven, 1986 ²	No. 2 4.9 y Female	Child's mother admitted to frequent use of water ingestion as punishment for bedwetting.	108 mEq/L	Emesis en route to hospital. Admitted to emergency room in status epilepticus. Unconscious, responsive only to deep pain. CT scan obtained 1 hour after admission showed generalized cerebral edema.	Multiple bruises on back and thighs; hand print on right flank. Height and weight compatible with a 2.5-year-old girl.	Initially treated with diphenhydantoin and naloxone for seizure control. Later, 90 mL of 3% NaCl administered to treat hyponatremia; approximately 12 hours later, regained consciousness. When child became alert and conversant, stated she was forced to drink water and was repeatedly beaten for "bad behavior." Placed in foster care at discharge.
Arieff & Kronlund, 1999 ³	No. 3 16 y Female	Foster mother forced developmentally disabled child to drink.	109 mEq/L	Emesis, seizures, and fecal incontinence. Calculated water retained was 6.6 liters. Suffered respiratory arrest at home; comatose on admission.	Multiple bruises on face, breasts, hands, and legs. Burns from electric iron.	History of forced water intoxication not provided to physicians, nurses, or emergency medical personnel. Intubated and mechanically ventilated within minutes

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