Water intoxication and hyponatraemic convulsions in neonates

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SUMMARY We studied two neonates fed diluted formula and excessive water who developed hyponatraemic convulsions; treatment included intravenous hypertonic saline and water restriction. Educating mothers is important to stop recurrences.

From 1967 to 1983 there were 24 cases of infants with water intoxication reported in the literature; their ages ranged from 3 weeks to 11 months.1-4 We report two neonates with seizures secondary to water intoxication.

Case reports

CASE 1

A 20 day old girl, the product of a full term, normal delivery, was the first child born to a healthy 20 year old mother. The baby had been well since birth. On the day of admission she was taken to hospital because of irritability and slight abdominal distension not associated with vomiting or diarrhoea. The physical examination was unremarkable and after reassuring the mother the child was sent home. One hour later the baby had a tonic-clonic convulsion and was readmitted to hospital where she was treated with intravenous diazepam. Blood was taken for biochemical and microbiological investigations. The child was given 5% dextrose in one fifth normal saline intravenously.

Physical examination on admission (after intravenous diazepam) showed an unconscious child with a rectal temperature of 36.5°C, pulse rate 120/minute, and respiratory rate 36/minute; there was no anaemia, jaundice, or oedema. The anterior fontanelle was open and soft, the abdomen was slightly distended with normal bowel sounds, and there was no hepatosplenomegaly. The patient responded to deep pain by moving her extremities; her pupils were equal and reactive to light.

The white cell count was 5.37×10⁹/l with 60% polymorphonuclear cells and 40% lymphocytes, and the haemoglobin concentration was 107 g/l. A microscopic examination of the urine was normal with a specific gravity of 1.005. The blood urea nitrogen was 3.2 mmol/l and the blood glucose concentration 7.8 mmol/l. The concentration of sodium in the serum was 117 mmol/l, potassium 4.8 mmol/l, chloride 92 mmol/l, and carbon dioxide 15 mmol/l. The osmolality of the serum was 240 mmol/kg and of the urine 83 mmol/kg. The cerebrospinal fluid was normal; culture of blood, urine, and cerebrospinal fluid gave negative results.

Because of the severe hyponatraemia in an otherwise healthy infant a detailed history of feeding was taken from the mother. On the day before admission the baby had been given 2 oz of diluted formula consisting of one tablespoon of S26 powdered milk (Wyeth (Ireland) Ltd) in 3 oz of water every four hours; in between each feed the mother gave the infant 4 oz of water. Throughout this period she passed a large quantity of urine. The diagnosis of hyponatraemia caused by excessive feeding of water was made and the baby was managed by restricting fluid intake. No further convolution occurred and the serum electrolytes became normal on the following day.

CASE 2

An 8 day old boy, the fifth child of an impoverished family, was born at term after a normal vaginal delivery, weighing 3020 g. The Apgar scores were 9 and 10 at one and five minutes, respectively. The baby had no problem during his nursery stay. At home he was fed 2 oz of a normal dilution of S26 infant formula consisting of 1 oz of S26 powder in 3 oz of water every four hours. On the day before admission the baby was given 2 oz of water every hour between feeds.

The baby had been well until the day before admission when, between feeds, he was given 2 oz of water. This continued for the next day and on the day of admission. On admission he was a well built Asian boy of 8 days. He had fair hair and skin, and was smiling. He had no jaundice, oedema, or hepatosplenomegaly. He had a distended abdomen with normal bowel sounds. He did not respond to deep pain. The rectal temperature was 36.5°C, the pulse rate 120/minute, and the respiratory rate 36/minute. The child was unresponsive to stimuli.

Blood examination showed a white cell count of 5.37×10⁹/l with 60% polymorphonuclear cells and 40% lymphocytes. The haemoglobin concentration was 107 g/l and the blood glucose concentration 7.8 mmol/l. The blood urea nitrogen was 3.2 mmol/l, sodium 117 mmol/l, potassium 4.8 mmol/l, chloride 92 mmol/l, and carbon dioxide 15 mmol/l. The osmolality of the serum was 240 mmol/kg and of the urine 83 mmol/kg. The cerebrospinal fluid was normal; culture of blood, urine, and cerebrospinal fluid gave negative results.

Because of the severe hyponatraemia in an otherwise healthy infant a detailed history of feeding was taken from the mother. On the day before admission the baby had been given 2 oz of diluted formula consisting of one tablespoon of S26 powdered milk (Wyeth (Ireland) Ltd) in 3 oz of water every four hours; in between each feed the mother gave the infant 4 oz of water. Throughout this period she passed a large quantity of urine. The diagnosis of hyponatraemia caused by excessive feeding of water was made and the baby was managed by restricting fluid intake. No further convolution occurred and the serum electrolytes became normal on the following day.
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every two hours followed by 2 oz plain water. On
the day of admission the baby became lethargic and
ted poorly. He developed intermittent tonic-clonic
seizures which lasted for three hours. In the
emergency room the baby was given 15 mg pheno-
barbitone intravenously. His convulsions stopped
but they recurred several times and could not be
controlled by phenobarbitone, diazepam, calcium
gluconate, or glucose.

On admission his temperature was 36°C, pulse
rate 112/minute, and respiratory rate 38/minute. He
weighed 3140 g. He was unconscious and was having
tonic-clonic convulsions; his anterior fontanelle
was slightly tense; he was not oedematous. The rest
of the physical examination was normal. Laboratory
investigations showed a serum sodium concentration
of 116 mmol/l, chloride 86-9 mmol/l, potassium 4-99
mmol/l, carbon dioxide 16-9 mmol/l, glucose 7-2
mmol/l, calcium 2-2 mmol/l, and phosphorus 2-02
mmol/l. Culture of blood, urine, and cerebrospinal
fluid gave negative results.

The seizures stopped after 20 ml of 5% sodium
chloride was given intravenously; the boy had no
further seizures.

Discussion

These two infants had no history of any salt losses to
account for the hyponatraemia and appeared clinically
well hydrated with no evidence of oedema. From the
history of excess water intake, hypothermia, low serum
osmolality, low serum sodium concentration, normal serum blood urea nitrogen and creatinine we concluded that the babies had dilutional hyponatraemia after an increased water
intake. Case 1 was the first child of an inexperienced
mother. The second case was the fifth child of an
impoverished family; water intoxication occurred because of feeding the child large amounts of water.

Most infants with water intoxication have
hypothermia, are sleepy or irritable, and when
seizures occur they are often multiple and recurrent.
Some cases reported had oedema and hypertension;
hyponatraemia with a sodium concentration of less
than 125 mmol/l, a low chloride, and low carbon
dioxide concentration was common. In one of our
cases as well as cases reported by others,1-4 the
blood urea nitrogen was higher than the normal
range for their age,5 which might reflect a blood
volume contraction due to shifting of water from the
extracellular fluid to the cell when hyponatraemia
occurred; the transient rise in blood glucose concen-
tration was presumably caused by the seizures and
stress.1

The mechanism of hyponatraemia is controversial:
inhomogeneous secretion of antidiuretic hormone or
inability of the kidney to excrete excess water have
been suggested.2 In young infants kidney function is
immature, and the glomerular filtration rate is only
30% of that of a normal adult.6 When infants ingest
large amounts of water over a short period of time
their kidneys are unable to excrete the large water
load; this results in a dilution of their serum sodium,
and salt depletion can further impair water excretion.

In the young infant with a strong sucking reflex,
however, a baby might be satisfied with sucking and
ingest excess water if it is continually offered by the
mother. Crumpacker and Kriel theorised that
infants continue to drink excess water because they
are hungry.3

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