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CASE REPORT

Fatal voluntary salt intake resulting in the highest ever documented sodium plasma level in adults (255 mmol L^{-1}): a disorder linked to female gender and psychiatric disorders

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Abstract. Ofran Y, Lavi D, Opher D, Weiss TA, Elinav E (Hadassah University Hospital, Jerusalem, Israel). Fatal voluntary salt intake resulting in the highest ever documented sodium plasma level in adults (255 mmol L^{-1}): a disorder linked to female gender and psychiatric disorders (Case Report). *J Intern Med* 2004; **256**: 525–528.

Excessive ingestion of salt is a well-recognized cause of hypernatraemia in children, is uncommonly recognized in debilitated elderly persons, but is rarely diagnosed in healthy, independent adults. We report a case of fatal salt poisoning in a 20-year-old lady who suffered of post-natal depression and ingested large quantities of salt as part of exorcism ritual. She presented with the highest ever documented serum sodium level of 255 mmol L^{-1}, associated with severe neurological impairment that was unresponsive to aggressive hypotonic fluid replacement. Post-mortem examination ruled out any other possible probable cause of death. The medical literature was reviewed, and 16 previous cases of severe hypernatraemia in adults secondary to excessive salt ingestion were retrieved. Common features of all reported cases included female gender (95% of cases) and evidence of underlying cognitive or psychiatric disorders (all reported cases). We conclude that women with documented cognitive or psychiatric disorders, in particular depression, are susceptible for psychogenic salt poisoning. Awareness should be raised to the potentially life-risking use of salty beverages as emetics or as part of 'exorcism' rituals.

Keywords: hypernatraemia, oral, psychiatric, sodium.

Introduction

Hypernatremia secondary to dehydration or to excessive saline administration is common in nursery-home dwelling elderly individuals, but is extremely rare in young, healthy adults. In infants and young children, oral ingestion of excessive amounts of salt occurs either accidentally [1–5] or intentionally in abuse crimes [6, 7]. In hospitalized patients, hypernatraemia is usually secondary to erroneous intravenous administration of sodium. Despite salt's wide availability in the general population, exogenous oral salt ingestion rarely causes hypernatraemia severe enough to induce clinical symptoms or death, perhaps due to its foul taste. Risk factors for oral salt poisoning in adults have not been previously identified.

We report a case of severe fatal hypernatraemia (255 mmol L^{-1}) in a young adult, caused by psychogenic ingestion of large amounts of salt. All previous reports of oral salt poisoning in adults after 1966 are reviewed, and the common clinical features and risk factors of this rare manifestation are discussed.

Case report

A 20-year-old previously healthy woman was diagnosed of suffering of postpartum depression 2 weeks following delivery of her first child. Antidepressive fluoxetine treatment was initiated by her family doctor. Concomitantly, the patient participated, in her family's advice, in a local ceremony of 'exorcism'. During this act the patient was ordered

to drink large amounts of salty water. Reportedly, the patient drank six glasses of a mixture of 1 kg table salt in a litre of water.

Eleven hours later, the women became lethargic and apathetic and developed a general convulsive episode. On arrival to the emergency department, the patient was deeply unconscious, with a blood pressure of 110/60, respiratory rate of 15, heart rate of 120, and temperature of 36 °C. The estimated Glasgow coma scale score was 5. Breathing was shallow. Pulmonary, cardiac and abdominal examinations were normal. Other than the severely impaired consciousness, neurological examination was unremarkable, with reactive pupils, no evidence of meningeal irritation, normal, intact tonus of all four limbs, and normal, symmetrical reflexes.

Admission serum sodium level was 255 mmol L^{-1}, with identical results noted in three repeated blood examinations. Serum sodium level was also determined by a separate laboratory, yielding similar results. Also noted were mild renal failure (creatinine of 138 μmol L^{-1}), hyperuricaemia (569 μmol L^{-1}) and mildly elevated lactic acid levels (3.19 mmol L^{-1}). Complete blood count and the rest of the biochemistry results were within normal range. TSH level was normal, and blood levels of alcohol, acetaminophen, tricyclic antidepressants and lithium were undetectable. Urinary toxic screen and gastric lavage toxic screen were repeatedly negative. Chest radiography, head CT and lumbar puncture were unremarkable. Blood and urine cultures were taken and were later demonstrated to be sterile.

The patient was intubated and admitted to the ICU. Despite full intensive treatment and aggressive hypotonic fluid resuscitation the patient rapidly deteriorated and died a few hours after arrival. Postmortem examination did not recognize any pathological finding that would explain the patient's presentation and eventual death, other than fatal hypernatraemia.

Discussion

As early as the 1960s and early 1970s, table salt was used as an emetic agent. In early additions of Harrison's *Principles of Internal Medicine* the use of saline emetics in acute poisoning was advocated [8]. When toxicity of excessive sodium administration was identified, its use as an emetic was abandoned. It has been well documented that as little as two tablespoons of salt (30 g) can rapidly elevate serum sodium concentration by as much as 30 mEq, depending on body weight [8, 9]. Such rapid elevation of sodium levels can result in serious neurological consequences. Oral ingestion of salty beverages is still being used for complementary medicinal purposes and as part of spiritual rituals. Nevertheless, oral administration of sodium is an extremely uncommon cause of symptomatic hypernatraemia, as healthy adults resist the taste of excess amounts of salt and do not ingest more than small quantities of salty substances.

In the presented case, the participating individual in the 'exorcism' ritual was ordered to ingest large amounts of sodium, resulting in the development of severe hypernatraemia of 255 mmol L^{-1}, leading to profound neurological compromise and consequently death. The ability to consume such large quantities of salty water is peculiar. The 'spiritual' environment and the attendance of a large number of close family members in the exorcism ceremony might have prompted the patient to resist her natural distaste and ingest the highly salty beverage. The patient's depressive disorder may have contributed to her obedience and compliance with the drinking, whilst depression has been suggested to alter the sense of taste in a minority of individuals [10].

Evaluation of risk factors that are associated with voluntarily exogenous and hazardous salt ingestion was performed using a search of the medical literature from 1966 to 2004, by review of Medline records. Seventeen cases (16 previous reports, in addition to the presented patient) of severe hypernatraemia secondary to oral administration of sodium were identified in the medical literature and are depicted in Table 1.

One case was excluded from our discussion because the severity of salt poisoning was not determined. Symptoms and the eventual fatality in this patient were due to causative damage and oesophageal perforation and not solely due to hypernatraemia [11]. Two other cases cannot be used in the assessment of risk factors, because salt was ingested involuntarily. One described a fisherman whose fishing boat was sunk by a hurricane, who has spent 11 h at sea and swallowed a considerable amount of seawater [12]. The other case described a lethal involuntary salt poisoning in

Table 1 Characteristics of cases of salt poisoning

Author	Sex	Age	Reason of ingestion	Mentally or emotionally disorder	Amount of salt ingested	Time of ingestion	Time (h) to arrival	Admission serum sodium (mEq L^{-1})	Outcome
This study	F	20	Emetic	Depression	<1000 g	Minutes	11	233	Died
Winter and Taylor [19]	F	21	Emetic		300–600 g	Minutes	?	227	Died
Greshman and Mashru [22]	F	48	Emetic		20 g	Minutes	24	166	Died
Bird *et al.* [20]	F	35	Emetic	Untitled psychiatric	60 g	Minutes	?	200	Died
McGouran [23]	F	54	Emetic	disorder	Unknown	Minutes	21	185	Died
Anders [26]	F	36	Exorcism		1000 g	Minutes	24	246	Died
Robertson [18]	F	23	Emetic	Followed an attempt to	Unknown	Minutes	4	214	Died
Laurence and Hopkins [17]	F	35	Emetic	commit suicide	78 g	Minutes	2	184	Died
Hey and Hickling [16]	F	56	Emetic		100 g	Minutes	4	214	Died
Calam *et al.* [15]	F	27	Emetic		<1000 g	Minutes	27	175	Died
Roberts and Noakes [24]	F	26	Emetic		150 g	Minutes	3	172	Died
Moder [27]	M	41	Mistake	Down's syndrome	70 g	Minutes	12	209	Died
Addleman *et al.* [14]	F	85	Mistake	Dementia	Unknown	Several hours/days	Unknown	193	Survived
Johnston and Robertson [9]	F	45	Mistake	Prader–Willi	80 g	Minutes	3	190	Died
Hedouin *et al.* [13]	F	19	Exorcism	None	Unknown	Minutes	4	153	Died
Ellis [12]	M	35	Near drowning		Unknown	11 h	1	175	Survived

a healthy 19-year-old woman. During a criminal 'exorcism' she was brutally forced to drink salty water and at the same time was being flogged on her soles with the aim of healing postsurgical epilepsy [13]. The local imam (Muslim priest) who conducted the ceremony was judged by a French criminal court for torture and act of barbarity and sentenced to 7 years of imprisonment. Our report is the third reported case ever of excessive sodium ingestion as part of exorcism rituals.

The remaining 14 cases of adult orally caused hypernatraemia were reviewed in search for common features and risk factors. All patients suffered of documented cognitive or psychiatric disorders. Three of the patients suffered of dementia [14], Down's syndrome [8] and Prader–Willi syndrome [9]. Four patients ingested excessive salt as part of a suicide attempt [15–18]. Seven patients (including our patient) were diagnosed of suffering of other psychiatric disorders [19–24]. Only one patient was a male, whilst all others were females. The amount of ingested salt, time to admission and admission serum sodium levels were variable, did not follow any characteristic pattern, and are not clearly correlated with adverse outcomes.

The small number of documented cases and the fact that only two patients survived their sodium ingestion limits the ability to construct a valid statistic model for the assessment of prognosis from admission data. Nevertheless, it is suggested from the data that ingestion of salt for a longer period of time prior to admission (days) is associated with better prognosis, whilst rapid ingestion of large quantities of salt (minutes–hours) was uniformly associated with bad prognosis. Therefore, acute hypernatraemia should be treated by rapid serum sodium correction of 1–2 mmol L^{-1} h^{-1}, whereas chronic hypernatraemia should be treated with a slower rate of sodium correction of 0.5 mmol L^{-1} h^{-1} [25].

Our findings suggest that mental or emotional disorders are crucial for voluntarily ingestion of toxic amounts of salt. We suggest that this phenomenon be called 'psychogenic salt intake'. Although female gender is predominant in the literature, it can reflect cultural gender differences dealing with emotional disorders and not a real physiological difference. We call for increased awareness by practising doctors to this rare, yet widely available, form of intoxication.

Conflict of interest statement

No conflict of interest was declared.

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