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Case Report Open Access

Two Autopsy Cases of Water Intoxication

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Abstract

We here report two autopsy cases of men with an intellectual disability who died from water intoxication.

(Case 1) A 22-year-old man was found dead in a prone position in his room. Autopsy and histological findings revealed the edema of brain and lung. The serum Na value was 108 mEq/L.

(Case 2) A 23-year-old man suddenly fell and was found unconscious. Autopsy and histological findings revealed the edema of brain and lung. In lung tissue, deposition of fibrin around the vessels, was found. The serum Na value was <100 mEq/L.

On the basis of these findings, we concluded that they were died from water intoxication and hyponatremia as a result of massive drinking.

We also discuss new autopsy findings that support the diagnosis of water intoxication and we investigate the serum Na value of autopsy cases (N=17) in order to analyses the postmortem change of serum Na value.

Keywords: Forensic science; Water intoxication; Intellectual disability; Hyponatremia; Autopsy; Deposition of fibrin

Introduction

Water intoxication is a serious condition that results from drinking massive volumes and is characterized by hyponatremia, ataxia, and spasm, often resulting in coma. There are a number of reports of water intoxication in psychiatric patients, such as those with schizophrenia, intellectual disability, or pervasive developmental disorder) [1-16]. Previous reports indicate that this condition is related to the syndrome of inappropriate antidiuretic hormone secretion [8-12], and delayed treatment can result in serious consequences [17]. Other reports are related to forced drinking as a result of abuse [13,18-21], iatrogenic reasons, or excessive irrigation during endoscopic surgery in gynecological or gastrointestinal settings [17,22].

We report 2 autopsy cases that were considered to be water intoxication and discuss new autopsy findings in support of diagnosis. We also analyzed serum Na value in order to observation the change of postmortem serum Na value.

Case Reports

Case 1

A 22-year-old man was admitted to an institution owing to intellectual disability. He was found dead in a prone position in his room. Approximately 10 days before his death, he had repeatedly drunk considerable volumes, followed by vomiting.

Autopsy findings: The patient's height and weight were 180 cm and 82.4 kg, respectively. The external examination revealed congestion of the facial region and red-colored fluid in the nasal and oral cavities.

The brain weighed 1540 g, with congestion. The heart weighed 415 g, and sclerosis and stenosis of the coronary arteries were not detected. The lungs weighed 670 g (left) and 750 g (right) with a high degree of swelling and presence of red-colored fluid in the trachea and bronchi. The bladder was extremely expanded and contained 910 cc of urine.

Histological analyses revealed prominent congestion and edema of the lung tissue (Figure 1). Other organs did not show any significant findings. Serum Na value was 108 mEq/L.

Case 2

A 23-year-old man with an intellectual disability entered an institution because of polydipsia. He had habitually and repeatedly drunk considerable volumes and experienced diarrhea and vomiting. This behavior was uncontrollable; therefore, his family decided to admit him. The night of the day following his admission, he suddenly fell and was found unconscious. The patient died despite immediate transport to the emergency room by ambulance.

Autopsy findings

The patient's height and weight were 166 cm and 49.4 kg, respectively. The external examination revealed no significant findings except a contusion on the facial region that resulted from his fall.

The brain weighed 1383 g, with congestion. The heart weighed 328 g, and sclerosis and stenosis of the coronary arteries were not detected. The lungs weighed 422 g (left) and 509 g (right) with a high degree of swelling; the trachea and bronchi were empty. The greater curvature of the stomach was ruptured because of cardiac massage, and 3100 cc of fluid with food debris was observed in the intraperitoneal space (Figure 2). The bladder was empty, likely because of urethral catheterization.

Histological analyses revealed edema of the subarachnoid space. Protrusion and surrounding vacuolization were observed at the cardiac vessels (Figure 3a). A portion of the cardiac muscle bundles was expanded (Figure 3b). The lungs showed fluid in the bronchi (Figure

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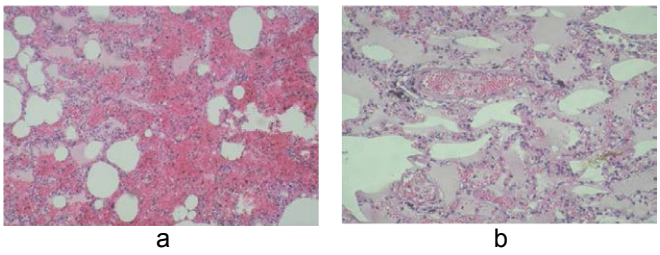

Figure 1: Congestion and edema of the lung tissue. (a) ×100 Hematoxylin-Eosin staining, (b) ×200 Hematoxylin-Eosin staining.

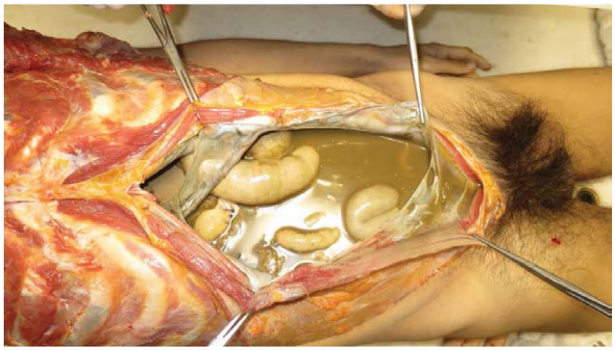

Figure 2: Fluid with food debris was observed in the intraperitoneal space.

4a), expansion of the capillary vessels, and deposition of fibrin around the vessels (Figure 4b and 4c). The kidney showed edema of the tubular epithelium. Serum Na value was <100 mEq/L.

Evaluation of Serum Na Values

To investigate changes in the postmortem Na value, we investigated the serum Na value in 17 autopsy cases from our institution and evaluated the relationship between the Na value and time after death (12–168 h). In this analysis, the serum Na value was between 109 and 138 mEq/L, and the Na value was low in almost all of the cases, compared with the normal Na range (135-145 mEq/ L). No relationship between the Na value and time after death (12-168 h) was detected. Two cases with a Na value <110 (Na=109 and 110) had both received a massive transfusion before death.

Discussion

In previous reports of water intoxication, the diagnostic criteria included excessive drinking, presence of large volumes of fluid in the stomach, macroscopic and histological evidence of edema of the brain and lung tissue, a low serum Na value, and the absence of endogenous diseases as the cause of death [13].

The serious consequences of water intoxication can result from hyponatremia progression, which involves loss of consciousness, coma, and death, or from asphyxia as a result of aspiration of vomited water during decreased consciousness. In addition, brain herniation has been previously determined to cause fatalities from water intoxication; water intoxication causes changes in serum osmotic pressure leading to brain edema, and brain edema often results in brain herniation. The serum Na value in these previous cases was approximately lower than 120 mEq/L; therefore, brain herniation, rather than hyponatremia, was considered the cause of death.

Brain herniation was not observed in the present cases; we considered water intoxication as the cause of death owing to the excessive drinking, and judging from the macroscopic and histological evidence of edema of the brain and lung tissue, low serum Na value, and absence of endogenous diseases that could result in death.

The cause of hyponatremia was considered the long-term antipsychotic drug use; these drugs tend to stimulate the hypothalamus. Furthermore, the majority of water intoxication cases are psychiatric patients, such as those with schizophrenia. The stimulation of the hypothalamus can result in polydipsia and increase extracellular fluid because of the change in serum osmotic pressure. Moreover, antidiuretic hormone secretion was increased, and the serum Na value was low, resulting in severe hyponatremia.

However, patients who are not administered antipsychotic drugs can also experience water intoxication, indicating that other causes exist. First, polydipsia occurs, drinking increases, and self-induced water intoxication occurs, resulting in hyponatremia. Therefore, hyponatremia can result in the serious consequences of water intoxication and provides proof that hyponatremia is an important diagnostic criterion for water intoxication.

However, at autopsy, the use of the serum Na value for water intoxication diagnosis may not be reliable because of postmortem changes [23]. In the present analysis, no relationship between the Na value and time after death was detected. Furthermore, 2 cases with a Na value <110 mEq/L (Na=109 and 110 mEq/L) had both received a massive transfusion before death. Therefore, we consider that the postmortem change in the serum Na value was affected by antemortem circulating body fluid volume.

Case 1 did not receive a transfusion; therefore, the serum Na value was remarkably low before death, and he was diagnosed with hyponatremia. The serum Na value in Case 2 was also very low (<100 mEq/L). Although Case 2 received a transfusion, we considered the serum Na value to be very low before death because we did not detect Na value <100 mEq/L in any cases in our analytical study. Therefore, we suggest that the serum Na value in Case 2 decreased to <100 mEq/L not only because of the transfusion but also as a result of drinking a massive amount before death.

In Case 2, fibrin deposition in the lungs, edema in the heart, and edema in the kidney were found; these findings have not been reported previously. The deposition of fibrin was considered to be a result of plasma component discharge from the vessels. This phenomenon seems to occur because of changes in serum osmotic pressure and endothelial cell disorders owing to chronic, repeated drinking of massive volumes.

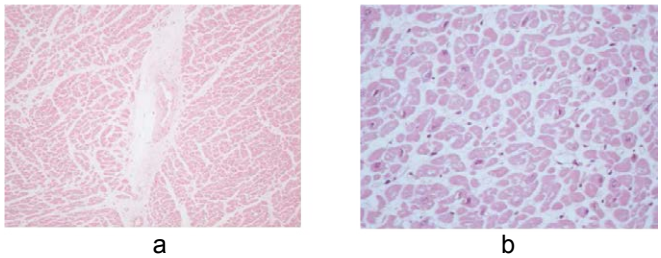

Figure 3: Histological findings of heart tissue. (a) Surrounding vacuolization of the cardiac vessels (× 100 Hematoxylin-Eosin staining) (b) A portion of the cardiac muscle bundles was expanded (× 400 Hematoxylin-Eosin staining).

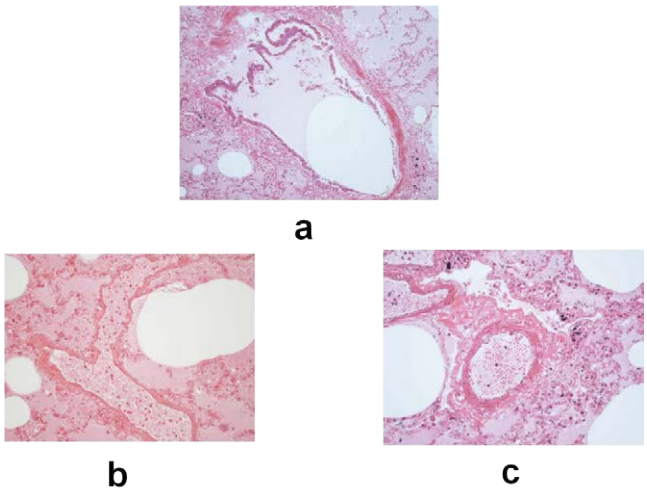

Figure 4: Histological findings of lung tissue (a) Fluid in the bronchi (× 100 Hematoxylin-Eosin staining) (b) (c) Deposition of fibrin around the vessels (× 200 Hematoxylin-Eosin staining).

We believe the autopsy findings of the present cases and analyses of the postmortem serum Na value are helpful to diagnose water intoxication, and water intoxication should be considered during autopsy in cases of schizophrenia or intellectual disability.

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