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Berkeley Scientific Journal

Title

Water Intoxication

Permalink

<https://escholarship.org/uc/item/438611v2>

Journal

Berkeley Scientific Journal, 17(2)

ISSN

1097-0967

Author

Lingampalli, Nithya

Publication Date

2013

DOI

10.5070/BS3172020102

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Undergraduate

Water Intoxication

Nithya Lingampalli

Water constitutes up to 75% of a human body's composition during infancy, and although this percentage declines to 45% in old age, it is still a large component of your body mass (Hall et al., 2011). Given the enormous amount of water that is present in a human body, it would be expected that an increase in water consumption would have little to no impact on its functions. However, it turns out that a body's homeostatic balance is significantly more delicate than anticipated, and even a few extra ounces of water can manifest as negative physical symptoms. Hyponatremia, also known as hyperhydration and water intoxication, is a state in which the body's water levels are disrupted by an excess of water retention and this imbalance is exhibited through various physiological symptoms including strokes, coma, and death in severe cases (Water intoxication symptoms; Coco Ballantyne, 2007).

Hyponatremia is a word translated from its Latin and Greek roots to mean, "insufficient salt in the blood," which is an apt name given that it is a condition characterized by excessive levels of water retained in the body which then cause a dilution of salt and electrolytes to the point where they are no longer functional. This leads to the disruption of the kidney's normal functioning and thereby causes many physical problems (Coco Ballantyne, 2007). There are multiple degrees of severity as well as persistence and the symptoms associated with these levels vary as well. Chronic hyponatraemia is when the blood sodium level drops over time. On the other hand, Acute hyponatraemia, or water intoxication, is when it drops over a shorter period of time and is thus much more dangerous and has more severe symptoms (Stöppler). Medically, this disease is defined as a serum sodium level of less



Figure 1. The human body is approximately 75% water during infancy, this percentage drops down to 45% into adulthood.

than 135 mEq/L and is characterized as an acute neurological disturbance due to the fact that brain cells swell and disrupt normal functioning. (Hyponatremia (water intoxication)). However, as we will examine later on, the exact procedure for diagnosis will vary with the population in question.

The biological basis for this condition is based on the abnormal retention of water by the kidneys due to various neurological and gastrointestinal problems. The extra water within the body dilutes the electrolytes and salt also present to a very weak concentration. As a result, the body's cells are forced to absorb this water in order to restore this concentration and return to homeostasis. However, the inflammation of cells continues and disrupts other bodily functions until eventually the swelling reaches brain cells and causes cerebral edema that then results in strokes, coma, or death (Farrell et al., 2003; Coco Ballantyne, 2007).

accessible material and as a result, they attempt to over-dose by over-consumption (Water intoxication alert). Schizophrenic patients are also observed to have a higher risk of contracting this condition due to their imbalanced mental state. Studies show this to be true especially among inmate populations when other methods of suicide may be inaccessible (Schoenly, 2012). There are also biological conditions that can put you at a higher risk for water intoxication including hypothyroidism, cirrhosis, and cortisone deficiency (Addison's Disease) as all these conditions affect the water and electrolyte balance within your body (Water intoxication symptoms). Furthermore, taking medications such as antidepressants, diuretics and sulfonylurea drugs also has a negative impact as they decrease blood sodium levels when prescribed to treat other symptoms (Stöppler, Water intoxication symptoms.).

A biological syndrome known as Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) also plays a role as it when the kidneys cannot function normally in excretion and thus begin to accumulate and excess of water (Water intoxication alert). This occurs because the posterior pituitary gland in the brain is stimulated to increase the secretion of an antidiuretic hormone known as vasopressin that causes the kidneys to increase the amount of water they conserve (Coco Ballantyne, 2007). SIADH is directly linked to hyponatremia and as a result, physicians often examine their patient's medical history for cases of hyponatremia when diagnosing them with SIADH (Thomas, 2013).

Water intoxication is very hard to detect in its early stages as it presents fairly ubiquitous symptoms such as headaches, confusion, nausea and vomiting that can be linked to a multitude of diseases (Farrell et al., 2003). Symptoms of water intoxication are actually very similar to that of alcohol intoxication in terms of the nausea and altered mental state that is caused (Julia).

The first symptom is always nausea as the stomach is unable to hold a greater than average amount of water. Next follow slurred speech, weakness, headache, bloating, hallucinations, and muscle cramps as the body attempts to regain homeostasis but fails as there is no way to excrete the excess water (Water intoxication symptoms). At this point,

in contrast to the other common signs, a unique characteristic of the disease appears in the form of psychotic symptoms such as the consumption of even more water in a crazed state (Farrell et al., 2003). After this point, the excess water begins affecting brain cells and causing them to swell in a condition known as cerebral edema. Apart from the impaired brain functioning, this condition is made more

includes the use of vasopressin receptor antagonists that inhibit the release of vasopressin from the posterior pituitary gland. As a result, the amount of vasopressin that impacts the kidneys is reduced and the body conserves less water, allowing for the excess to be naturally excreted (Water intoxication symptoms).

“Johns Hopkins Pediatric Center reported that they see at least three to four cases of water intoxication among infants every summer”

dangerous by the fact that the skull acts as a stiff constraining mechanism and the swelling increases overall pressure on the soft tissue of the brain (Stöppler). As result of the ever-increasing cranial pressure and impaired cerebral functioning, the body soon shuts down in a coma or experiences severe seizures that can eventually lead to death. It is for this reason that severe hyponatremia has a mortality rate of 50% among those who contract it due to the cerebral edema that causes the nervous system to fail if the cerebral inflammation is not relieved immediately (Bhananker et al., 2004).

Diagnosis of this problem generally consists of monitoring the body's sodium and salt content as well as the body fluid levels to determine exactly what extent the balance has been disrupted. The medical history is also examined for instances of prolonged vomiting, excessive sweating, previous blood tests, and urine tests (Stöppler). Treatment depends mainly on the amount of excess water consumed as that correlates with the amount of homeostatic imbalance present and the extent to which the body's systems have begun to fail. Early detection, as hard as it is, is necessary for these reasons in order to prevent the fatal onset that almost always results in life-threatening events such as seizures and comas (Farrell et al., 2003). If the condition is caught in the early stages, treatment with an IV fluid containing electrolytes can rectify the problem as it restores the normal salt concentration in the blood and reestablishes homeostasis (Julia). This can also be accomplished through the increased consumption of salty foods (Water intoxication symptoms). Treatment for more severe cases also

One form of this condition, self-induced hyponatraemia, generally ends up being an acute case that can only be treated through hospitalization and rapid intervention with hypertonic saline. It is generally a side effect of mental conditions such as severe depression and schizophrenia that include suicidal tendencies that lead to over-consumption. Any prolonged decrease in blood sodium levels increases the risk of permanent cerebral damage and the effects should be counteracted as quickly as possible. Induced urine output is also considered during treatment to restore the body to homeostasis as rapidly as possible without causing too drastic changes (Sterns et al., 2009).

Until recently this condition was thought to be most prevalent among athletes, especially long-distance or endurance based sports, who often overcompensated for their need to hydrate and thus experienced the negative effects of hyponatremia (Julia). Before the 1970's, athletes had prided themselves on feats such as running marathons without drinking any water. However, starting from the 1970's, athletes were advised to overcompensate for their thirst during training because previously they had been told that drinking fluids during exercise was harmful to their athletic performance. The negative impact of instruction to ingest “as much as tolerable” soon became apparent in 1981 when the first case of exercise-associated hyponatremia (EAH) occurred. Following this, more than 10 documented deaths from EAH have been reported since 1991 due to EAH and the encephalopathy that occurred as a result. Subsequent research has found that EAH is an entirely preventable condition and that



Figure 2. Drinking more than 72 oz of water a day is above the recommended limit if the body is not undergoing activity what requires water to be replenished.

Although over-retention of water is the main trigger for this condition, there are multiple mental and physical factors that can expedite its occurrence. This is especially a concern among patients who exhibit severe depression as they also have strong, recurrent thoughts of suicide. Water is a relatively

there is always a chance to prevent fatal outcomes provided that there is an early diagnosis. There is also a risk during treatment because the rapid infusion of electrolyte solutions can increase intracerebral pressure that can then cause coma, respiratory arrest, and brain death (Parrish).

Another population among which this condition is prevalent is infants and an article based on case studies at Johns Hopkins Pediatric Center reported that they see at least three to four cases of water intoxication among infants every summer that generally involve multiple seizures. Although these seizures are not harmful in the long run to the baby's health, they are severe and can be prevented. An infant is particularly susceptible to seizures from water intoxication because it does not have enough sources in its diet to replace the extra salts (Pesheva, 2008) Sometimes children with specific chronic illnesses can meet the medical definition for the diagnosis of hyponatremia, however they do not actually have the disease and the calculation is a side effect of their pre-existing chronic condition. Serum sodium increase is the generally prescribed treatment, especially for infants, and at a specific rate of less than 1 mEq/L (Hyponatremia (water intoxication)).

Hyponatremia came into the popular view through cases of deaths that were highly publicized due to their unexpectedness. One of the most recent is the story of a woman that competed in a contest of who could drink the most water before needing to urinate. The prize for the challenge was a free Wii that this woman attempted to win for her children. Although she reported feeling normal at the end of competition, she had severe nausea and headaches when driving back home. Given that she was not hospitalized in time, the symptoms escalated until she died from an extreme seizure. As a result of the amount of negative publicity the competition received as a result of her death, the channel canceled the competition and warned viewers about the possibility of hyponatremia.

Although from the context of this article it may seem that hyponatremia is a highly prevalent disease, it is actually relatively rare within the general population. However, there are always precautions that can be taken to ensure that even the most negative

symptoms are not felt. Anyone who is drinking more than 72 oz. of water a day is above the recommended limit, unless they are involved in a situation where bodily fluids must be replenished rapidly. Intake should be restricted to about 1-1.5 quarts a day, but based on height, weight, and other bodily factors, some people may still be at risk for hyponatremia at that amount (Water intoxication alert).

REFERENCES

1. Bhananker, S. M., Paek, R., & Vavilala, M. S. (2004). Water intoxication and symptomatic hyponatremia after outpatient surgery. *Anesthesia and Analgesia*, 98(5), 1294-1296. doi: 10.1213/
2. Coco Ballantyne (2007, June 27). *scientificamerican.com*. Retrieved from <http://www.scientificamerican.com/article.cfm?id=strange-but-true-drinking-too-much-water-can-kill>
3. Farrell, D. J., & Bower, L. (2003). Fatal water intoxication. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1770067/>
4. Hall, John E., and Arthur C. Guyton. *Guyton and Hall Textbook of Medical Physiology*. Philadelphia, PA: Saunders/Elsevier, 2011. Print.
5. Hyponatremia (water intoxication). (n.d.). Retrieved from <http://easypediatrics.com/hyponatremia-water-intoxication>
6. Julia, L. (n.d.). How stuff works. Retrieved from <http://science.howstuffworks.com/life/human-biology/water-intoxication.htm>
7. Parrish, Carol R., R.D., M.S. "Water Intoxication - Considerations for Patients, Athletes and Physicians." *Nutrition Issues in Gastroenterology* 66th ser. (2008): 46-53. School of Medicine at the University of Virginia. Web. 18 Mar. 2013. <<http://www.medicine.virginia.edu/clinical/departments/medicine/divisions/digestive-health/nutrition-support-team/nutrition-articles/NoakesArticle.pdf>>.
8. Pesheva, E. (2008, May 14). Too much water raises seizure risk in babies. Retrieved from <http://www.hopkinschildrens.org/newsdetail.aspx?id=4844>
9. Schoenly, Lorry. "Water Intoxication and Inmates: Signs to Watch out for." *Correctionsone.com*. Correctionsone.com, 8 May 2012. Web. 11 Mar. 2013.
10. Sterns, R.H., Nigewekar, S.U., & Hix, J.K. (2009). The treatment of hyponatremia. *Semin Nephrol*, 29(3), 282-299. doi: 10.1016/j.semnephrol.2009.03.002
11. Stöppler, M. C. (n.d.). Hyponatremia (low blood sodium). Retrieved from <http://www.medicinenet.com/hyponatremia/article.htm>
12. Thomas, Christie P. "Syndrome of Inappropriate Antidiuretic Hormone Secretion." Ed. Vecihi Batuman. *Medscape Reference*. WebMD, 25 Feb. 2013. Web. 11 Mar. 2013. <<http://emedicine.medscape.com/article/246650-overview>>.
13. Water intoxication alert. (n.d.). Retrieved from http://www.pwsausa.org/support/water_intoxication_alert.htm
14. Water intoxication symptoms. (n.d.). Retrieved from <http://www.buzzle.com/articles/water-intoxication-symptoms.html>