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Case Report

Transient Central Diabetes Insipidus Occurring After Vasopressin Infusion

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ABSTRACT

Objective: The common causes of central diabetes insipidus (CDI) include trauma to the pituitary, hypoperfusion, and malignancy. However, CDI can also be transient. An emerging cause of transient diabetes insipidus is through the use and withdrawal of vasopressin. Here, we present a case of transient CDI that developed during an intensive care unit admission.

Case report: A Caucasian woman presented to the emergency room after a fall. On presentation, the patient was found to be in shock and was admitted to the surgical intensive care unit. Treatment with norepinephrine, vasopressin, and intravenous antibiotics was started. On day 5 of hospitalization, the patient's blood pressure improved, and treatment with vasopressin was discontinued. On day 6 of hospitalization, the patient's urine output increased and serum sodium level was elevated. Despite increasing free water, serum sodium level continued to rise. Endocrinology division was consulted, and urine osmolality was consistent with diabetes insipidus (DI). Urine osmolality at 30 and 60 minutes after desmopressin (1-desamino-8-d-arginine vasopressin [DDAVP]) was consistent with CDI. Magnetic resonance imaging scan of the brain showed no intracranial pathology. Over the next day with scheduled DDAVP, serum sodium level decreased below the goal level. Thus, DDAVP was held. Prior to discharge, the patient did not require additional DDAVP. She was discharged without DDAVP.

Discussion: Our patient's workup was initially consistent with CDI. However, the DI resolved spontaneously, supporting transient CDI secondary to vasopressin infusion. Different theories have emerged about why this occurs with vasopressin. However, further investigation is needed.

Conclusion: Although rare, it is important to monitor for DI after vasopressin infusion and have a suspicion that DI may be transient in the absence of a clear cause.

Introduction

Central diabetes insipidus (CDI) manifests through a decreased secretion of arginine vasopressin (AVP) from the posterior pituitary. Diabetes insipidus (DI) is characterized by increased hypotonic polyuria, hypernatremia, and polydipsia. The common causes of CDI include trauma to the pituitary or hypothalamus, hypoperfusion, and malignancy.[1]

An emerging and increasingly discussed cause of transient diabetes insipidus (tDI) is through the use and withdrawal of vasopressin in the setting of shock. Previously, a large portion of reports and reviews involved neurosurgical patients, which led to the theory of possible neuropathology-associated risk factors (ie, subarachnoid hemorrhage and manipulation near or at the pituitary).[1,2] However, with more emerging data, it is becoming clear that tDI is not restricted to patients with preceding neurologic insults. We present a case of transient CDI that developed during an intensive care unit admission for septic shock secondary to a necrotic sacral ulcer after a fall in the absence of any intracranial pathology.

Case Report

An elderly Caucasian woman with a past medical history of atrial fibrillation, cardiomyopathy, Graves disease, hypertension, hyperlipidemia, and obesity presented to the emergency room after sustaining a fall 11 days ago. She fell off the couch at home and was unable to get up. The patient declined to receive help during the

Abbreviations: AVP, arginine vasopressin; CDI, central diabetes insipidus; DDAVP, 1-desamino-8-d-arginine vasopressin; DI, diabetes insipidus; tDI, transient diabetes insipidus.

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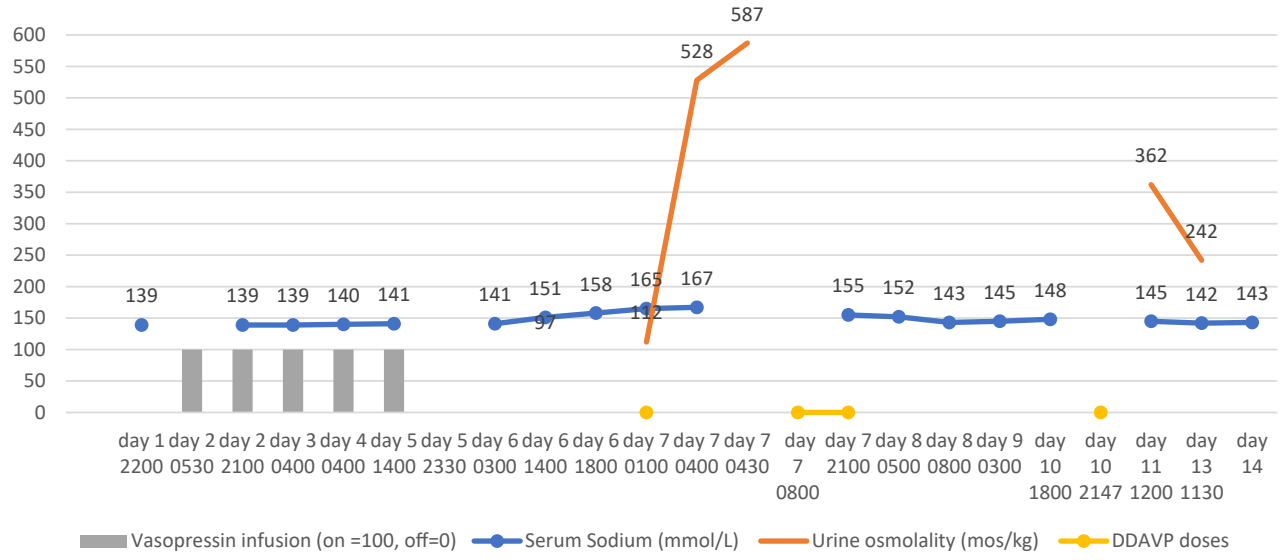

Fig. 1. Concurrent timeline of serum sodium level, urine osmolality, and vasopressin infusion. *DDAVP* = 1-desamino-8-d-arginine vasopressin.

previous 11 days until her husband called Emergency Medical Services because of her altered mental status. Other than altered mental status, there was no concern for head trauma.

On presentation, the patient was found to be in atrial fibrillation with rapid ventricular response and had an extensive sacral wound. Workup demonstrated combined septic and hypovolemic shock with leukocytosis with a leukocyte count of 20 000 K/μL. She was intubated and admitted to the surgical intensive care unit. Her hemodynamic status was stabilized after the initiation of norepinephrine and vasopressin treatment, and she was started on treatment with intravenous antibiotics, including piperacillin/tazobactam and linezolid. Computed tomography scan of the head at the time of admission was negative for any acute intracranial pathology.

On day 2 of hospitalization, the patient underwent debridement of wounds on buttock and posterior aspect of the right thigh. In addition, the patient had a diverting colostomy performed due to the proximity of the wound to the anus. The patient's blood pressure continued to improve postoperatively, and treatment with vasopressin was discontinued on day 5 of hospitalization.

On day 6 of hospitalization, the patient's urine output increased drastically (6.8 L over a 24-hour period). At the same time, sodium level was noted to be 151 mmol/L with previously normal levels. Free water was increased in the patient's tube feeds. Serial serum sodium continued to trend up during the next 24 hours despite an increase in free water. Endocrinology division was consulted on day 7 of hospitalization after the serum sodium level rose to a peak of 167 mmol/L.

During the initial consultation, the differential diagnosis included CDI caused by apoplexy given the recent hypotension or nephrogenic DI from acute tubular necrosis. However, it was also noted that since the admission, the patient had been on continuous vasopressin infusion for shock, which was discontinued the night before the first elevated serum sodium level was observed. Urine osmolality was obtained to differentiate between solute diuresis and DI and was found to be 112 mos/kg, consistent with DI. Next, 2 μg of subcutaneous desmopressin (1-desamino-8-d-arginine vasopressin [DDAVP]) was administered, and urine osmolality at 30 and 60 minutes after the administration of the dose was found to be 528 and 587 mos/kg, respectively, consistent with neurogenic DI or CDI. With a diagnosis of DI, subcutaneous DDAVP at 1 μg was administered every 12 hours with close monitoring of fluid intake and output. The estimated free water deficit was 7 L with a goal replacement of 3.5 L, or half of the water deficit, in the first 24 hours. In terms of hypothalamic pituitary adrenal axis, random cortisol and adrenocorticotropic hormone levels were 30 μg/dL and 37 pg/mL, respectively. Free thyroxine, thyroid-stimulating hormone, and total triiodothyronine at 0.5 ng/dL, 3.6 μU/mL, and 43 ng/mL, respectively, suggested sick euthyroid syndrome. Insulin-like growth factor 1 level was within the normal range, and prolactin level was mildly elevated at 32.7 ng/mL. A magnetic resonance imaging scan of the brain showed no pituitary, sellar, or suprasellar mass and no other acute intracranial pathology.

Over the next 24 to 36 hours with subcutaneous DDAVP administration, serum sodium level began to decrease below the goal sodium level of 145 mmol/L, down to 143 mmol/L on day 8 of hospitalization. The patient also developed pulmonary edema. Thus, intravenous fluids were decreased, and DDAVP was held. Serum sodium level stabilized to 140 to146 mmol/L, and the patient did not require any DDAVP for more than 24 hours. However, on day 10 of hospitalization, she did require 1 additional dose of 0.5 μg DDAVP due to increasing urine output and a serum sodium level of 148 mmol/L (course has been summarized in Fig. 1). For the following 6 days until discharge, the patient did not require additional DDAVP, and serum sodium level remained between 140 and 146 mmol/L. She was discharged without DDAVP to a long-term acute care hospital with plans for continued serum sodium monitoring.

Discussion

Our patient's workup was initially consistent with CDI, with an elevated serum sodium level, a low urine osmolality, and a marked response to DDAVP. However, the DI resolved spontaneously throughout her hospital course, suggesting a transient picture. While evaluating the patient's medications and other factors during her stay, the cause of transient CDI was thought to be related to her continuous vasopressin infusion that was stopped the night prior to her serum sodium rising. Cases similar to this have been reported in the literature. A retrospective study by Ferenchick et al[3] described 1896 patients who received vasopressin during episodes of shock. Of those, 29 patients (1.53%) experienced tDI after the

discontinuation of vasopressin. In a control group consisting of 1320 patients who received norepinephrine for shock support, only 2 patients (0.15%) experienced DI. Specifically, none of the 29 tDI patients had neurointerventions. This information supports the theory that vasopressin discontinuation itself outside other risk factors is the likely cause of tDI. These findings, however, do not answer the question of the mechanism of action behind the event. A case report published by Peskey et al[4] provides multiple theories about the cause, with the focus being CDI. The case discusses a patient with transient polyuria and hypernatremia again after the discontinuation of vasopressin. A theory they raise, which has not been discussed here, is the possibility that the body's own supply of AVP is depleted during an episode of shock. Based on this hypothesis, when the vasopressin was discontinued in our patient, the endogenous supply could have still been too low to be effective, leading to CDI. This theory would explain the transient nature of the CDI episode, as when the body repleted its store of AVP, the patient recovered.

Other case reports have described patients with tDI after the discontinuation of vasopressin who responded appropriately to DDAVP administration, similar to the subject of this case report.[5,6] This response supports the theory that the V2 receptors in the kidney are functioning appropriately and the cause of DI, in this case, is central in nature. Until recently, V2 receptors have only been found in the kidneys. A study by Sato et al,[7] published in 2011, showed that this may not be the case. Through rat models, V2 receptors were discovered on AVP neurons. The theory is that these receptors act during hypo-osmolar states to help AVP neurons recover from osmotic swelling through an autocrine pathway initiated by the hypothalamus' release of AVP. Therefore, V2 receptors may be involved in tDI through an entirely different mechanism, highlighting the complexity of the pathophysiology. Different theories have emerged focusing on the downregulation of V2 receptors in the kidneys, hypoperfusion to the hypothalamus and/or pituitary during shock, and suppression of DDAVP production by exogenous vasopressin.[2,3,6] It is important to note that these theories explain the event as both central and nephrogenic. As such, new information is emerging to suggest the presence and role of V2 receptors in a centrally mediated fashion. Prospective studies have not been conducted to investigate the underlying pathophysiology of DI after vasopressin. This is an area that could benefit greatly from further investigation.

Conclusion

We present a case of transient CDI developing in a patient treated with vasopressin for septic shock, with no intracranial abnormalities, trauma, or evidence to suggest pituitary pathology. Her CDI ultimately resolved spontaneously with no evidence of recurrence. Although rare, it is important to monitor for DI after prolonged infusions of vasopressin and have a suspicion that DI may be transient in the absence of a clear cause.

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Disclosure

The authors have no multiplicity of interest to disclose.

References

1. Garrahy A, Moran C, Thompson CJ. Diagnosis and management of central diabetes insipidus in adults. *Clin Endocrinol (Oxf)*. 2019;90(1):23–30.
2. Bohl MA, Forseth J, Nakaji P. Transient diabetes insipidus after discontinuation of vasopressin in neurological intensive care unit patients: case series and literature review. *World Neurosurg*. 2017;97:479–488.
3. Ferenchick H, Cemalovic N, Ferguson N, Dicpinigaitis PV. Diabetes insipidus after discontinuation of vasopressin infusion for treatment of shock. *Crit Care Med*. 2019;47(12):e1008–e1013.
4. Peskey CS, Mauermann WJ, Meyer SR, Abel MD. Vasopressin withdrawal associated with massive polyuria. *J Thorac Cardiovasc Surg*. 2009;138(2):491–492.
5. Kim K, Mody N, Chernoff A, Gupta S, Lekprasert P, Patarroyo-Aponte G. Transient diabetes insipidus after vasopressin use in a patient with Wernicke's encephalopathy. *J Clin Transl Endocrinol Case Rep*. Published online July 1, 2020. https://doi.org/10.1016/j.jecr.2020.100067
6. Carman N, Kay C, Petersen A, Kravchenko M, Tate J. Transient central diabetes insipidus after discontinuation of vasopressin. *Case Rep Endocrinol*. 2019;2019:4189525.
7. Sato K, Numata T, Saito T, Ueta Y, Okada Y. V2 receptor-mediated autocrine role of somatodendritic release of AVP in rat vasopressin neurons under hypo-osmotic conditions. *Sci Signal*. 2011;4(157):ra5.