EDORIUM Journals

Int J Case Rep Images 2021;12:101241Z01NM2021.
www.ijcasereportsandimages.com

CASE REPORT PEER REVIEWED | OPEN ACCESS

Central diabetes insipidus as a manifestation of cerebral edema in a patient with SARS-CoV-2 infection

Nilesh Mhaskar, Zachary A Gilbert

ABSTRACT

SARS-COV-2, the virus responsible for coronavirus disease 2019 (COVID-19), has been associated with various clinical manifestations ranging from an asymptomatic carrier state to pneumonia and respiratory failure, encephalopathy, thromboembolic events, and death. The objective of this case report is to highlight an additional complication possible with COVID-19: central diabetes insipidus (CDI) in the setting of fulminant cerebral edema. A 66-year-old male presented with cough, shortness of breath, and fever and was found to have COVID-19 pneumonia. During the hospitalization, he developed acute hypernatremia with a significant increase in urine output associated with low urine osmolarity. Central diabetes insipidus was confirmed by administration of desmopressin. The presence of CDI along with worsening neurologic changes prompted cerebral imaging revealing intraparenchymal hemorrhages and significant edema. To our knowledge, this is the first report of CDI caused by cerebral edema in a patient with COVID-19. We present this rare association to help alert clinicians to the possibility of polyuria and CDI as a sign of potentially fatal neurologic sequelae of COVID-19.

Keywords: Central diabetes insipidus, Cerebral edema, COVID-19, SARS-COV-2

Nilesh Mhaskar[1], MD, FASN, Zachary A Gilbert[2], MD

Affiliations: [1]Renal Physicians Inc., 500 Lincoln Park Blvd, Kettering, OH, USA; [2]Department of Internal Medicine, Kettering Medical Center, 3535 Southern Blvd, Kettering, OH, USA.

Corresponding Author: Nilesh Mhaskar, 500 Lincoln Park Blvd, Kettering, OH 45429, USA; Email: nmhaskar@gmail.com

Received: 24 February 2021
Accepted: 07 June 2021
Published: 16 July 2021

How to cite this article

Mhaskar N, Gilbert ZA. Central diabetes insipidus as a manifestation of cerebral edema in a patient with SARS-CoV-2 infection. Int J Case Rep Images 2021;12:101241Z01NM2021.

Article ID: 101241Z01NM2021

****

doi: 10.5348/101241Z01NM2021CR

INTRODUCTION

COVID-19, also known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified in Wuhan, China in December 2019. Fever, cough, dyspnea, and bilateral infiltrates on chest imaging indicative of pneumonia are the most common presenting symptoms [1]. Additional complications include acute respiratory distress syndrome (ARDS) [2], arrhythmias, acute cardiac injury and shock [3], thromboembolic events [4], anosmia and ageusia [5], and gastrointestinal manifestations such as diarrhea and nausea/vomiting [6]. Intracranial complications such as cerebral edema have been described, but to our knowledge there have been no reported cases in which specific renal complications heralded the development of neurologic manifestations. We present a case in which a gentleman contracted COVID-19 through close family contact. During his hospitalization, he developed acute severe hypernatremia leading to the diagnosis of CDI which ultimately led to the discovery of fulminant cerebral edema. We believe this unique case will help inform clinicians about the potential for renal and neurologic conditions that may affect the clinical course and prognosis of patients with COVID-19.

CASE REPORT

Patient is a 66-year-old male with past medical history significant for gastroesophageal reflux disease,

hypertension, atrial fibrillation status post-radiofrequency ablation, and benign prostatic hyperplasia who presented to the emergency department with fever, shortness of breath, and cough. Approximately one to two weeks prior to admission, his wife was diagnosed with COVID-19 and the patient had been in close contact with her without any personal protective equipment. One week prior to admission he developed fever, chills, myalgias, cough and shortness of breath which progressively worsened. Three days before admission, he reported intermittent diarrhea associated with nausea and vomiting. On arrival to the emergency department, the patient was found to be hypoxic with oxygen saturation 71% on room air requiring up to 6 liters of oxygen administered via nasal cannula. COVID-19 was confirmed through the qualitative detection of SARS-CoV-2 viral RNA by rapid nucleic acid amplification.

Patient was started on dexamethasone, remdesivir, empiric ceftriaxone and azithromycin, and convalescent plasma, with ruxolitinib added shortly thereafter. Despite these interventions, however, the patient's respiratory status continued to deteriorate, initially requiring non-invasive ventilation and ultimately endotracheal intubation with mechanical ventilation on Hospital Day #4. On Hospital Day #5, he developed non-oliguric acute kidney injury with a creatinine of 2 mg/dL thought to be secondary to acute tubular necrosis, which remained unchanged over the course of his hospitalization. Over the next few days he became increasingly hypoxic associated with worsening bilateral infiltrates and markedly hypertensive requiring nicardipine infusion to control his blood pressure. Vancomycin and piperacillin/tazobactam were added out of concern for possible superinfection. Due to continued severe hypoxic respiratory failure despite maximal ventilatory support, discussions were begun to transfer the patient to a tertiary facility for extracorporeal mechanical oxygenation (ECMO).

While arrangements were being made for a possible transfer, the patient developed sudden acute hypernatremia to 167 mmol/L associated with significant increase in urine output, which persisted despite cessation of intravenous furosemide. Nephrology was consulted for evaluation of possible diabetes insipidus. On the day of consult, his repeated sodium was 170 mmol/L and the patient had 6.5 L of urine output for the 24 hours prior. In the presence of this significant hypernatremia, his urine osmolarity was found to be 170 mOsm/L confirming a free water diuresis. This was further supported by a urinalysis that was negative for glucose and urine sodium of 21. Desmopressin (DDAVP) at 1 mcg was administered intravenously to confirm the diagnosis and help distinguish between nephrogenic and CDI. Urine osmolarity increased substantially to over 700 mOsm/L with DDAVP confirming CDI (Figure 1). Neurologic exam off sedatives and paralytics at this time revealed no gag or corneal reflex and fixed pupils at 6 mm. These neurologic changes, along with the presence of CDI, led the clinicians to undertake a computerized axial tomography of the head which revealed intraparenchymal hemorrhages and significant edema (Figure 2). Neurosurgery and neurology were consulted but no neurosurgical intervention was deemed feasible given these significant findings. Transfer to the tertiary care center for ECMO was cancelled due to futility. Goals of care were changed to comfort care measures only and he expired shortly thereafter.

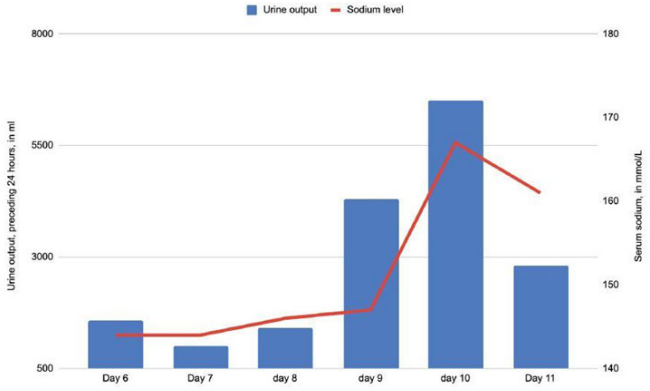

Figure 1: Urine output with serum sodium levels during hospitalization. DDAVP was administered on Day 10.

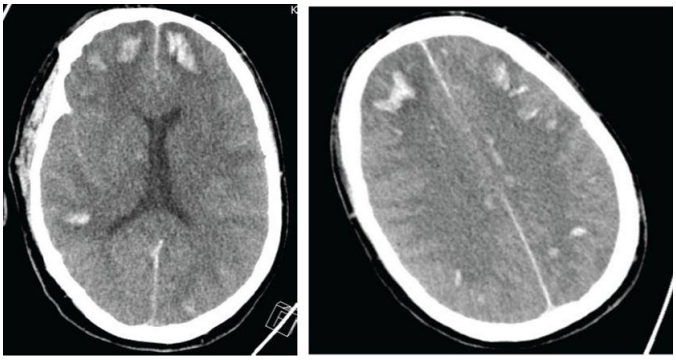

Figure 2: CT of head without contrast showing multiple small cerebral parenchymal hemorrhages bilaterally with diffuse brain swelling.

DISCUSSION

SARS-COV-2, the virus responsible for coronavirus disease 2019 (COVID-19), can cause a wide range of clinical manifestations from asymptomatic carrier to multiorgan failure and death. The dominant cause of morbidity and mortality has been pneumonia with respiratory failure requiring mechanical ventilation. COVID-19 disease has also been found to cause certain neurologic complications, including acute cerebrovascular disease, encephalitis, and encephalopathy [7]. Recently, fulminant cerebral edema has been described as a complication of COVID-19 disease. In that case report, significant cerebral edema resulted in herniation along with subcortical hemorrhages with focal infarction [8]. The pathogenesis of cerebral edema in COVID-19 has been postulated to be secondary

to a massive pro-inflammatory cytokine state, resulting in cerebral vasodilation, cerebral edema, and ischemia [9].

Central diabetes insipidus (CDI) is a disorder characterized by decreased production of antidiuretic hormone (ADH), commonly resulting in urinary water losses and polyuria. In the absence of adequate free water replacement, hypernatremia can ensue. The areas involved in ADH production are hypothalamic osmoreceptors, supraoptic and paraventricular nuclei, and the superior portion of the supraoptico-hypophyseal tract [10]. Disorders or injury to one or more of these areas can lead to CDI, as seen with transsphenoidal neurosurgery or infiltrative diseases such as Langerhans histiocytosis [11, 12]. Cerebral edema in particular has been associated with CDI in a number of clinical situations. Previous reports have described CDI as a consequence of cerebral edema following successful cardiopulmonary resuscitation [13], severe brain injury [14], and subacute liver failure [15]. While the exact etiology of CDI in cerebral edema is unclear, it has been theorized that injury or damage to the hypothalamus, pituitary stalk, or axon terminals in the posterior pituitary from inflammation and edema may be pathogenic mechanisms [16].

To our knowledge, this is the first report of CDI caused by cerebral edema in a patient with COVID-19 disease. Severe hypernatremia in the presence of polyuria and low urine osmolarity allowed for rapid diagnosis of CDI, and was confirmed by administration of DDAVP which led to a marked increase in urine osmolarity.

Importantly, the diagnosis of CDI and changes in the neurologic status actually led to a search for the presence of intracranial abnormalities and ultimately changed the clinical course and prognosis. Though the hypernatremia began improving with administration of DDAVP and free water, the poor clinical outcome was consistent with previous reports of cerebral edema and CDI [17].

CONCLUSION

In conclusion, we have confirmed the previous report that fulminant cerebral edema can develop in COVID-19 disease. Most significantly, however, we have for the first time shown the presence of CDI in this setting, which in fact signaled the development of cerebral edema. It is important for clinicians to be vigilant for polyuria and CDI in patients with COVID-19, as it should prompt an investigation into the presence of cerebral edema and may portend a poor prognosis.

REFERENCES

1. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395(10223):497–506.
2. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323(11):1061–9.
3. Arentz M, Yim E, Klaff L, et al. Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State. JAMA 2020;323(16):1612–4.
4. Danzi GB, Loffi M, Galeazzi G, Gherbesi E. Acute pulmonary embolism and COVID-19 pneumonia: A random association? Eur Heart J 2020;41(19):1858.
5. Spinato G, Fabbris C, Polesel J, et al. Alterations in smell or taste in mildly symptomatic outpatients with SARS-CoV-2 infection. JAMA 2020;323(20):2089–90.
6. Cheung KS, Hung IFN, Chan PPY, et al. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from a Hong Kong cohort: Systematic review and meta-analysis. Gastroenterology 2020;159(1):81–95.
7. Bridwell R, Long B, Gottlieb M. Neurologic complications of COVID-19. Am J Emerg Med 2020;38(7):1549.e3–1549.e7.
8. van den Enden AJM, van Gils L, Labout JAM, van der Jagt M, Moudrous W. Fulminant cerebral edema as a lethal manifestation of COVID-19. Radiol Case Rep 2020;15(9):1705–8.
9. Wu Y, Xu X, Chen Z, et al. Nervous system involvement after infection with COVID-19 and other coronaviruses. Brain Behav Immun 2020;87:18–22.
10. Rose BD, Post TW. Clinical Physiology of Acid-Base and Electrolyte Disorders. 5ed. New York: McGraw-Hill; 2001. p. 751
11. Seckl J, Dunger D. Postoperative diabetes insipidus. BMJ 1989;298(6665):2–3.
12. Dunger DB, Broadbent V, Yeoman E, Seckl JR, Lightman SL, Grant DB, Pritchard J. The frequency and natural history of diabetes insipidus in children with Langerhans-cell histiocytosis. N Engl J Med 1989;321(17):1157–62.
13. Choi SS, Kim WY, Kim W, Lim KS. Unexpected fatal hypernatremia after successful cardiopulmonary resuscitation with therapeutic hypothermia: A case report. J Korean Med Sci 2012;27(3):329–31.
14. Hadjizacharia P, Beale EO, Inaba K, Chan LS, Demetriades D. Acute diabetes insipidus in severe head injury: A prospective study. J Am Coll Surg 2008;207(4):477–84.
15. Shankar Hari M, Parsons AK, Burroughs AK, Shaw S, O'Beirne J, Agarwal B. Neurogenic diabetes insipidus presenting in a patient with subacute liver failure: A case report. J Med Case Rep 2010;4:232.
16. Amar A, Thornton E, O'Kelly P, Tormey W, Phillips J, Thompson CJ. Posterior pituitary dysfunction after traumatic brain injury. J Clin Endocrinol Metab 2004;89(12):5987–92.
17. Chae MK, Lee JH, Lee TR. Early central diabetes insipidus: An ominous sign in post-cardiac arrest patients. J Crit Care 2016;32:63–7.

****

Author Contributions

Nilesh Mhaskar – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Final approval of the version

to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Zachary A Gilbert – Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission
The corresponding author is the guarantor of submission.

Source of Support
None.

Consent Statement
Written informed consent was unable to be obtained as the patient is deceased from disease process and was not required by the local IRB. No protected health information or patient-identifying information is present in the article and every attempt was made to protect the identity of the patient.

Conflict of Interest
Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.