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CASE REPORT

Acute Renal Failure Secondary to *Vibrio cholera* Gastroenteritis in a United States Citizen, Corrected With Renal Replacement Therapy

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Abstract

Cholera is an acute gastroenteritis that can lead to fatal dehydration and metabolic derangements. Cases of cholera in the United States are typically associated with international travel. Patients who are persistently dehydrated despite aggressive rehydration and antibiotic therapy may require hemodialysis until symptom resolution and stabilization of renal function. We present a case of a 47-year-old male who recently returned from a trip to Haiti and presented with intractable abdominal pain, nausea, vomiting, and watery diarrhea. He was found to be in acute renal failure with a high anion gap metabolic acidosis of an unclear etiology. Abdominal imaging was consistent with enterocolitis, and his stool culture grew *Vibrio cholerae*. In addition to aggressive fluid resuscitation, he underwent two intermittent hemodialysis sessions and received sodium bicarbonate and antibiotic therapy. Renal function normalized by hospital day 6. This is a novel case of severe renal failure and high anion gap metabolic acidosis in a US patient with cholera; our review of the literature did not find any case reports regarding cholera in the past decade involving a US citizen.

Keywords: Cholera, Dialysis, High anion gap metabolic acidosis, Renal failure

1. Introduction

Cholera is an acute gastroenteritis that can lead to fatal dehydration and metabolic derangements.[1] It is caused by *Vibrio cholerae*, a gram negative, facultative anaerobic bacterium that dwells in marine environments.[1] The pathogen is typically transmitted through contaminated food or drink, with an approximated incubation period of 12 h to 5 days.[1] Upon invading the small intestine epithelial cells, it releases cholera toxin and induces watery diarrhea.[1,2] Cholera toxin's A subunit activates adenylate cyclase, leading to increased cyclic AMP, an efflux of chloride ions and other electrolytes from the cells, and consequently significant fluid loss into the small intestine.[1,2]

Outbreaks have been reported for the past two centuries, with the first known cholera pandemic from 1817 to 1824 originating in Bengal, India and the ongoing seventh pandemic originating in Indonesia in 1961.[1,2] There are 1.3−4 million cases of cholera yearly, with 21,000 to 143,000 deaths worldwide estimated to be secondary to cholera every year.[3,4] 1.3 billion people from 69 cholera endemic countries are at risk worldwide.[3,4] Prevention strategies include efforts to improve surveillance, sanitation, hydration resources, public education, as well as utilizing oral cholera vaccination.[3,4]

Volume repletion is the cornerstone of treatment.[1] Without antibiotic therapy, the duration of bacterial shedding through the stool is estimated to be under 5 days, although in rare cases the shedding period can last weeks.[1,5]

Cholera's complications include hypovolemic shock, acute kidney injury (AKI), hypokalemia, hypocalcemia among others.[6,7] This case describes a patient with cholera who acquired life threatening dehydration, renal failure and severe metabolic

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acidosis with a high anion gap (HAGMA) requiring hemodialysis (HD).

2. Case presentation

A 47-year-old male with a history of gastroesophageal reflux disease and hyperlipidemia presented with intractable abdominal pain, nausea, non-bloody, nonbilious emesis, and watery diarrhea. His symptoms started about 24 h prior to arrival. He estimated he had at least 10 episodes of emesis and 12 episodes of profuse watery diarrhea in the past 24 h.

He is an American citizen, and recently returned from a trip to Haiti 36 h ago. He drank only bottled water during his trip. He ate cooked freshwater fish the evening that he arrived in Haiti, approximately 48 h prior to symptom onset, and about 72 h before presenting to the hospital. He denied any consumption of oysters or other types of seafood during the remainder of his trip.

Prior to travel, he was asymptomatic. His home medications were rosuvastatin and omeprazole. He denied taking non-steroidal anti-inflammatory drugs. He had never been hospitalized before or required antibiotic therapy. He endorsed regular follow up with his primary care physician, and denied any past diagnosis of chronic kidney disease or acute kidney injury. He denied alcohol consumption or illicit drug use.

On physical exam, blood pressure was 88/60 mmHg, heart rate 87 beats per minute, respiratory rate 18 breaths per minute, and he was afebrile. He exhibited dry mucous membranes and mild diffuse abdominal tenderness.

Initial labs revealed a white blood cell count of 11,900/uL with an elevated absolute neutrophil count of 10,880/uL, bicarbonate level of 19 mmol/L, chloride 102 mmol/L, blood urea nitrogen (BUN) 27 mg/dL, creatinine 4.1 mg/dL, and an estimated glomerular filtration rate (eGFR) of 19 mL/min. Anion gap was 23 mmol/L on admission, and lactate level was 2.0 mmol/L. Serum acetone level was negative. Serum immunofixation studies, autoimmune workup, HIV testing and hepatitis screen were negative. Urine protein level was elevated at 104 mg/dL and urine creatinine was 326.

Computed tomography scan of abdomen and pelvis without contrast demonstrated mild distension of the small bowel with liquid stool throughout the colon, suggestive of enterocolitis (Fig. 1). Retroperitoneal ultrasound was unremarkable.

He was admitted to the telemetry floor. As his hypotension resolved after receiving intravenous fluids, he was not clinically in shock and there was low concern for sepsis; he remained afebrile. White blood cell count normalized by hospital day 2.

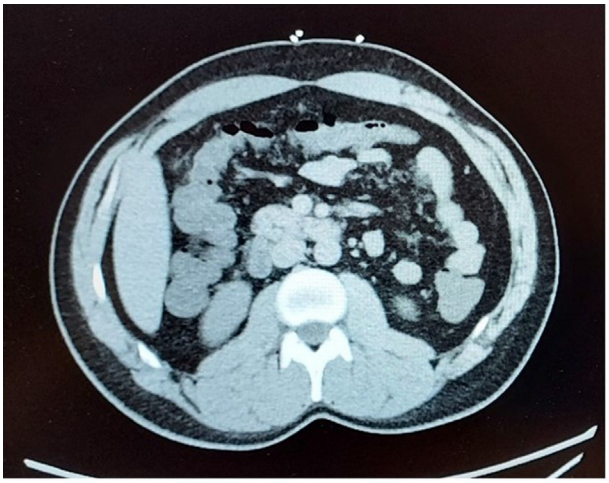

*Fig. 1. **CT scan suggestive of enterocolitis**. CT scan of the abdomen and pelvis without contrast demonstrated mild free distension of the small bowel, with liquid stool throughout the colon.*

Stool culture grew *Vibrio cholerae. C. difficile* testing was negative. Shiga toxin I and II, Campylobacter antigen and ova and parasite tests in the stool were negative.

Despite aggressive intravenous fluid resuscitation, renal function continued to worsen. By hospital day 3, BUN was 56 and creatinine rose to 7.4 with an eGFR of 10. Bicarbonate reached a nadir of 8 with a high anion gap peak of 33 mmol/L. On arterial blood gas, pH was 7.27, pCO2 29 mmHg, PO2 104, and $HCO3^-$ 13 mmol/L on room air. He was persistently hypokalemic, continued to have numerous episodes of emesis and diarrhea daily. He was started on a sodium bicarbonate drip with minimal improvement; thus, the decision was made to transfer him to the intensive care unit and start hemodialysis.

He underwent two intermittent hemodialysis sessions over hospital days 3 and 4. Following hemodialysis as well as additional intravenous sodium bicarbonate, eGFR stabilized to >60 by hospital day 6 (Table 1). He received one dose of 1000 mg of azithromycin after stool culture results were available on day 4, and then 300 mg of doxycycline every 12 h until symptoms fully resolved on day 7.

3. Discussion

This is a unique case of cholera causing acute renal failure with severe metabolic acidosis and high anion gap of unclear etiology.

AKI and HAGMA are known complications of cholera gastroenteritis. Vakrani and Nambakam's 2021 retrospective study, involving 55 cholera patients in Bengaluru, found that 56.4% had severe

Table 1. ***Correction of acute renal failure with high anion gap metabolic acidosis.*** *This table shows the patient's key lab values including anion gap trend over 7 days. He also received two sessions of intermittent hemodialysis (iHD 1 and 2) between hours 48 and 60 of his hospital course.*

	Time Elapsed (hours)	eGFR (mL/min)	BUN (mg/dL)	Serum HCO3 (mmol/L)	AG (mmol/L)	K (mmol/L)
	0	19	27	19	23	4.8
	24	16	46	16	22	3.5
	48	10	56	8	33	3.2
iHD 1 →						
iHD 2 →	60	12	41	20	21	2.8
	72	27	21	24	18	2.6
	96	21	44	27	13	2.6
	120	>60	22	21	14	3.5
	168	>60	23	23	13	3.2

diarrhea (defined as greater than 10 diarrhea stools per day), 92.7% had vomiting, and 94.5% had hypovolemic shock.[7] Moreover, 78% had an AKI, 32.7% had metabolic acidosis, and 32.7% of these patients underwent HD during their hospitalization.[7] Among the 43 patients who had an AKI, 18 (41.9%) of them required hemodialysis, and had never received HD prior to hospitalization.[7] This study did not record the occurrence or severity of high anion gap metabolic acidosis in these patients, but past case reports of HAGMA in cholera cases suggest that an elevated anion gap can largely be explained by the concomitant lactic acidosis with acute renal failure.[7,8]

Cholera can cause severe electrolyte imbalances and AKI, but with appropriate threapy, patients can have complete recovery, as was the case for this patient.[6,9] Vakrani et al.'s study suggests that, if cholera patients with acute renal failure are treated with antibiotics, aggressive fluid resuscitation and renal replacement therapy as needed during hospitalization, the majority of them will return to baseline renal function by approximately hospital day 5.[7] However, this study only involved 43 cholera patients who developed AKI[7]; additional studies with larger sample sizes need to be conducted in order to develop more definite conclusions.

Of note, patients with cholera can acquire significant azotemia, with some patients recorded to have blood urea nitrogen levels exceeding 100 mg/dL.[9] The patient in this case was suspected to have a low baseline BUN, so his azotemia with a BUN of 56 was a drastic increase relative to his normal levels.

Although his acute renal failure and persistent watery diarrhea can help to explain his severe metabolic acidosis, the etiology of this patient's severely elevated anion gap of 33 is unclear. Curiously, the most likely culprits in this patient's case, lactate and ketone bodies, were not elevated. The patient denied any history of illicit drug use or any substance abuse.

An alternative explanation for his HAGMA, which unfortunately could not be tested for during his admission, is an elevated plasma D-lactate. Serum lactate in mammals is typically comprised of L-lactate, and is what is measured in standard lactate assays.[10] D-lactate is the non-physiologic enantiomer of lactate in humans, as it is produced through the rare methylglyoxal pathway.[10] D-lactic acidosis can occur rarely in humans, typically associated with cases of short bowel syndrome.[10] Colonic bacteria can ferment the unabsorbed carbohydrates, thereby producing organic acids such as D-lactate.[10,11] D-lactic acidosis can also be found in cases of diabetic ketoacidosis, or triggered by high carbohydrate intake following a state of starvation.[10,11] Thus, D-lactate acidosis should be considered in the differential for this patient, given his severe volume loss and prolonged starvation state, with an otherwise unexplained HAGMA.

This case also stands out because this patient was a resident of the US. The CDC approximates that the yearly number of cholera cases in the US is between 0 to 5.[3] Our review of the literature in the past 10 years only found medical case reports of cholera located outside of the US.[5–7,9,12] Cases reported in the US are usually in the context of contaminated food consumption or recent travel outside of America.[3] Loharikar et al.'s study found that 111 cases of cholera were reported to the CDC in the US from 2001 to 2011, with 81% of them associated with international travel.[13]

4. Conclusion

This is a unique case of cholera gastroenteritis in a US citizen causing renal failure and HAGMA of unclear etiology. This case is noteworthy because there are minimal case reports in the medical literature concerning cholera in US citizens. Additionally, his high anion gap metabolic acidosis was not explained by the typical causes of HAGMA in cholera patients, as lactate and ketone levels were normal.

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Conflicts of interest

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References

1. Kanungo S, Azman AS, Ramamurthy T, Deen J, Dutta S. Cholera. *Lancet*. 2022;399:1429–1440. https://doi.org/10.1016/S0140-6736(22)00330-0.
2. Crisan CV, Hammer BK. The *Vibrio cholerae* type VI secretion system: toxins, regulators and consequences. *Environ Microbiol*. 2020;22(10):4112–4122. https://doi.org/10.1111/1462-2920.14976.
3. World Health Organization. *Cholera*; 2022. Accessed May 27, 2023. https://www.who.int/news-room/fact-sheets/detail/cholera.
4. Ali M, Nelson AR, Lopez AL, Sack DA. Updated global burden of cholera in endemic countries. *PLoS Neglected Trop Dis*. 2015;4(6):e0003832. https://doi.org/10.1371/journal.pntd.0003832, 9.
5. Weil AA, Begum Y, Chowdhury F, et al. Bacterial shedding in household contacts of cholera patients in Dhaka, Bangladesh. *Am J Trop Med Hyg*. 2014;91(4):738–742. https://doi.org/10.4269/ajtmh.14-0095.
6. Qasem A, Rabbani SA. Acute kidney injury associated with cholera. *Cureus*. 2023;15(1):e34101. https://doi.org/10.7759/cureus.34101.
7. Vakrani GP, Nambakam T. Retrospective study on acute kidney injury among cholera patients in an outbreak in whitefield, Bengaluru. *Internet J Nephrol*. 2021;2021:6682838. https://doi.org/10.1155/2021/6682838.
8. Wang F, Butler T, Rabbani GH, Jones PK. The acidosis of cholera. Contributions of hyperproteinemia, lactic acidemia, and hyperphosphatemia to an increased serum anion gap. *N Engl J Med*. 1986;315(25):1591–1595. https://doi.org/10.1056/NEJM198612183152506.
9. Tariq M, Memon M, Jafferani A, et al. Massive fluid requirements and an unusual BUN/creatinine ratio for prerenal failure in patients with cholera. *PLoS One*. 2009;4(10):e7552. https://doi.org/10.1371/journal.pone.0007552.
10. Ewaschuk JB, Naylor JM, Zello GA. D-lactate in human and ruminant metabolism. *J Nutr*. 2005 Jul;135(7):1619–1625. https://doi.org/10.1093/jn/135.7.1619.
11. Kowlgi NG, Chhabra L. D-lactic acidosis: an underrecognized complication of short bowel syndrome. *Gastroenterol Res Pract*. 2015;2015:476215. https://doi.org/10.1155/2015/476215.
12. Igere BE, Okoh AI, Nwodo UU. Non-serogroup O1/O139 agglutinable Vibrio cholerae: a phylogenetically and genealogically neglected yet emerging potential pathogen of clinical relevance. *Arch Microbiol*. 2022 May 14;204(6):323. https://doi.org/10.1007/s00203-022-02866-1.
13. Loharikar A, Newton AE, Stroika S, et al. Cholera in the United States, 2001-2011: a reflection of patterns of global epidemiology and travel. *Epidemiol Infect*. 2015 Mar;143(4):695–703. https://doi.org/10.1017/S0950268814001186.