CASE REPORT

Unusual cause of encephalopathy after brain surgery

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SUMMARY

For patients who have had a recent neurosurgical procedure, a visit to the emergency department for encephalopathy may automatically prompt a neurosurgical consult. We present a case of a patient with a history of Chiari malformation decompressed 6 months prior who presented with a 2-week history of slowly progressive altered mental status, headache and imbalance—symptoms consistent with her initial Chiari symptoms, so neurosurgery was consulted. Imaging showed no acute abnormality, but laboratory results revealed metabolic acidosis with high salicylate levels. When reporting medication use, this patient initially left out that she had been taking Goody's powder (845 mg aspirin) for headaches, and long-term use led to metabolic encephalopathy. Despite a recent history of surgery, it is important to keep the differential diagnosis broad especially when there are signs of metabolic derangement.

BACKGROUND

Symptoms of chronic salicylate toxicity such as lethargy, confusion and headaches can be similar to symptoms due to type I Chiari malformations.[1 2] Patients with type I Chiari malformations may undergo suboccipital craniectomy to relieve intracranial pressure and reduce brainstem compression.[3] The use of over-the-counter analgesic pain-relieving medications in the powder form is common. The chronic overuse of these medications (eg, BC Powder—845 mg aspirin and 65 mg caffeine) can be a cause of salicylate toxicity, and identification of their use during the patient history can aid in elucidating an aetiology for a patient's unexplained electrolyte disturbances and neurological complaints.

CASE PRESENTATION

A 54-year-old woman was brought to the emergency department after an episode of dizziness with a ground-level fall. She reported progressive confusion and lethargy for the past 2 weeks. On arrival, the patient had altered mental status and was somnolent but responded to voice. The patient has a history of type I Chiari malformation and underwent decompression surgery by suboccipital craniectomy 7 months prior. Prior to the craniectomy, the patient had been having similar symptoms of lethargy. She had reported initial improvements in her symptoms postsurgery except for suffering from headaches that have been persistent.

On examination, the patient had no visible trauma from the fall, and the postcraniectomy scar was well healed. She was oriented to person, place and time, but due to her altered mental status, a complete neurological examination was unable to be performed. Clonus was positive.

INVESTIGATIONS

CT imaging of the head on the day of arrival (figure 1, left) showed decreased cerebrospinal fluid space throughout the supratentorial and infratentorial compartments concerning for intracranial hypertension but no changes that would suggest renewal of Chiari symptoms. Laboratory results at initial presentation suggested a mixed respiratory alkalosis with metabolic acidosis and no anion gap. Her venous pH was 7.28 and venous partial pressure of carbon dioxide was 38, serum bicarbonate was 19 mEq/L, anion gap was 11 and salicylate level was 34 mg/dL. Patient was a regular user of BC Powder, sometimes up to 5 to 10 packets per day.

DIFFERENTIAL DIAGNOSIS

Metabolic encephalopathy from chronic aspirin abuse or complications of Chiari malformation.

TREATMENT

The patient was started on a sodium bicarbonate infusion with no operative management.

OUTCOME AND FOLLOW-UP

The next morning, her serum salicylate levels had decreased and urine was alkaline, so bicarbonate was discontinued. Her salicylate level fell to less than 2 mg/dL the next day, and a follow-up CT showed near complete resolution of the cerebral oedema (figure 1, right).

DISCUSSION

Chronic salicylate poisoning can be missed due to suspicion of a more acute process, the widespread use of salicylate medications in the general population and certain differences in presentation between acute and chronic salicylate poisoning.

Our patient presented with a salicylate level of 34 mg/dL, whereas acute symptoms of salicylate poisoning generally present at levels greater than 40 mg/dL. While this patient was above a therapeutic concentration of 30 mg/dL but still less than 40 mg/dL, chronic salicylate toxicity has been found in patients who have levels even below 30 mg/dL in the therapeutic concentration.[4] Though acute salicylate poisoning is classically associated with an anion gap metabolic acidosis, in our patient with chronic salicylate poisoning, the anion gap was not present.

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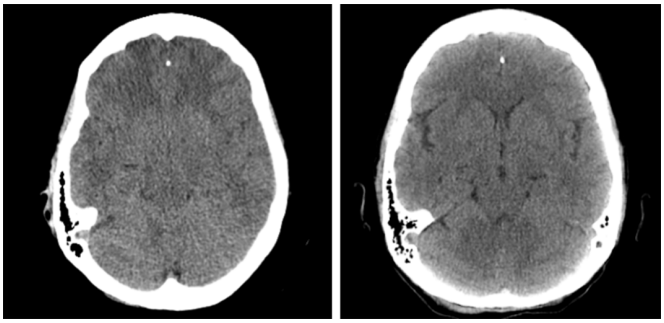

Figure 1 Axial CT at presentation (left) showing diffuse cerebral oedema with flattened gyri, lack of sulci, indistinguishable insula and collapsed cisterns. After resolution of metabolic derangement, the brain relaxed (right), and the patient recovered.

As previously described in the literature, the absence of an anion gap does not rule out salicylate toxicity.[5 6] A possible cause of normal anion gaps in the presence of salicylate poisoning has been attributed to laboratory machine measurement error from salicylate ions being incorrectly read as chloride ions.[5]

The pathophysiology of salicylate toxicity is due to multiple causes. Salicylates cause excessive stimulation of the respiratory centre leading to hyperventilation and respiratory alkalosis.[7] Salicylates also uncouple oxidative phosphorylation in mitochondria resulting in deficient ATP production which can lead to cell swelling and eventual lysis. The excess organic acids produced in anaerobic pathways along with, but to a lesser degree, salicylic acid itself cause a metabolic acidosis which favours the uncharged form of salicylic acid. The uncharged form of salicylic acid is able to more easily cross the blood–brain barrier where it can contribute to encephalopathy and cerebral oedema.[8]

Our patient received sodium bicarbonate in an attempt to alkalinise her pH and shift the balance towards the charged form of salicylic acid. Our patient's venous pH was increased from 7.28 at presentation to 7.46 about 2 hours after infusion. As salicylate toxicity can also cause respiratory alkalosis, the change in pH attributable to alkalinisation from sodium bicarbonate versus respiratory stimulation from salicylates cannot be fully separated. This does not preclude treatment with sodium bicarbonate as alkalaemia alone is not a contraindication.[9] Sodium bicarbonate also works by both increasing urinary salicylate excretion and decreasing reabsorption after being secreted in the proximal tubule. As more uncharged salicylate becomes charged on entering alkalinised urine, it causes further uncharged salicylate to be drawn into the lumen through diffusion. Thus, the charged form is suspected to be secreted more into the lumen when the urine is alkalinised in an attempt to reach equilibrium. When salicylate is charged, it is also hindered from being reabsorbed from the urine. It is also important to treat any existing hypokalaemia as urinary alkalinisation will be inefficient when the kidney excretes hydrogen ions into the lumen in an attempt to reabsorb potassium in exchange.[10]

Haemodialysis has been recommended for patients, such as ours, with altered mental status.[11] In our case, the patient's salicylate level was only moderately elevated, had normal renal function and had no evidence of pulmonary oedema on chest X-ray, so sodium bicarbonate infusion was attempted successfully instead.

Salicylate encephalopathy in a patient with prior neurological pathology such as Chiari malformation and craniectomy may be missed due to higher suspicion for prior known problems. Work-up of metabolic acidosis and a thorough medication history help identify these cases. Treatment with serum and urine alkalinisation using sodium bicarbonate or haemodialysis for more severe cases can rapidly correct the metabolic encephalopathy.

Learning points

- Symptoms of salicylate poisoning can be overlooked in a patient with a history of type I Chiari malformation.
- A normal anion gap should not be used to rule out salicylate poisoning.
- In a patient with normal renal function, no pulmonary oedema and only moderate salicylate elevation, sodium bicarbonate infusion may be successful without haemodialysis.

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Competing interests None declared.

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REFERENCES

1 Pearlman BL, Gambhir R. Salicylate intoxication: a clinical review. *Postgrad Med* 2009;121:162–8.
2 Schijman E. History, anatomic forms, and pathogenesis of chiari I malformations. *Childs Nerv Syst* 2004;20:323–8.
3 Pakzaban P. Medscape. Chiari malformation. 2016 http://emedicine.medscape.com/article/1483583-overview (cited 02 Feb 2017).
4 Proudfoot AT. Toxicity of salicylates. *Am J Med* 1983;75:99–103.
5 Kaul V, Imam SH, Gambhir HS, *et al*. Negative anion gap metabolic acidosis in salicylate overdose--a zebra!. *Am J Emerg Med* 2013;31:1536.e3–1536.e4.
6 Wright D, Sop J. Normal anion gap salicylate poisoning. *Am J Emerg Med* 2015;33:1714.e3–1714.e4.
7 Gabow PA, Anderson RJ, Potts DE, *et al*. Acid-base disturbances in the salicylate-intoxicated adult. *Arch Intern Med* 1978;138:1481–4.
8 Rauschka H, Aboul-Enein F, Bauer J, *et al*. Acute cerebral white matter damage in lethal salicylate intoxication. *Neurotoxicology* 2007;28:33–7.
9 Proudfoot AT, Krenzelok EP, Vale JA. Position paper on urine alkalinization. *J Toxicol Clin Toxicol* 2004;42:1–26.
10 Wax PM. Antidotes in Depth. In: Hoffman RS, Howland M, eds. *Goldfrank's Toxicologic Emergencies*. 10th edn. New York, NY: McGraw-Hill, 2015.
11 Juurlink DN, Gosselin S, Kielstein JT, *et al*. Extracorporeal treatment for salicylate poisoning: systematic review and recommendations from the EXTRIP workgroup. *Ann Emerg Med* 2015;66:165–81.

Unexpected outcome (positive or negative) including adverse drug reactions