The Interesting Case

Life-threatening hyperchloraemic acidosis in an azotaemic patient with normal serum creatinine

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Case

A 70-year-old man was admitted with pronounced dyspnoea and a 2 week history of progressively worsening diarrhoea and diminished urinary volume. The diarrhoea was described as watery stools without blood or mucus and was not ameliorated by loperamide. Anuria developed 2 days before admission. Fever, nausea, and abdominal or flank pain were absent.

In 1995 the patient had undergone abdominoperineal rectum resection and sigmoid colostomy as treatment for non-metastatic adenocarcinoma of the distal intestine (pT3N3M0, R0-resection). The patient received combined adjuvant treatment with pelvic radiotherapy (total dose 50.4 Gy delivered in a fractionated fashion) and 5-fluoruracil chemotherapy. Urinary retention developed as a complication of surgery. The patient performed intermittent self-catheterization three times a day. Two years later an abdominal computed tomography scan showed evidence of local recurrence and metastatic disease in the liver. Palliative therapy with endotoxin (Salmonella abortus equi, 4 ng/kg body weight) was started, of which the sixth cycle was given 20 days before the most recent admission.

On examination, the patient was awake, but mental status was altered. He presented with Kussmaul respiration. Vital signs were as follows: temperature 36.8°C, heart rate 88/min, respiration rate 25/min, and blood pressure 100/65 mmHg. Jugular venous distension was absent. Lungs were clear; cardiovascular and abdominal examination was otherwise unremarkable. No costovertebral angle tenderness was detected. Neurological examination was within in normal limits.

Laboratory tests revealed severe hyperchloraemic acidosis and uraemia. Arterial blood gases were pH 7.22, pCO₂ 9.2 mmHg and pO₂ 124.1 mmHg at room air; standard bicarbonate (HCO₃⁻) in arterial blood was 3.7 mmol/l and base excess (BE) was −20.6 mmol/l. Plasma electrolyte concentrations were: sodium (Na⁺) 150 mmol/l, potassium (K⁺) 3.6 mmol/l and chloride (Cl⁻) 126.3 mmol/l. The anion gap (Na⁺−(HCO₃⁻+Cl⁻)) was increased (20 mmol/l). Blood urea was 201 mg/dl, and creatinine 1.0 mg/dl. Haemoglobin, white blood cell count, platelet count, C-reactive protein, aminotransferases, phosphate, lactate, and blood sugar were normal. Stool cultures were negative. Urinalyses were not performed because of anuria. Ultrasonography showed an empty bladder with no signs of hydronephrosis; however, fluid-filled loops of bowel were visualized. A cystogram revealed a large fistulous tract between the urinary bladder and small intestine (Figure 1).

The patient received fluid substitution, bicarbonate and potassium infusions, and surgical treatment was planned. Two days later the diarrhoea ceased and urine flowed through the bladder catheter. The acidosis and uraemia reversed rapidly. Surgical treatment with excision of the fistula and direct closure was performed. Microscopic examination of the fistulous tract revealed late-stage radiation injury with signs of chronic inflammation and vascular damage with intimal fibrosis. No signs of malignancy were detected.

Discussion

Pathophysiology of acidosis after urinary diversion through intestinal segments

The pathophysiology of hyperchloraemic metabolic acidosis secondary to urinary—intestinal diversion has been the subject of multiple investigations [1,2] since its initial description in 1931 [3] (Figure 2). As the diverted urinary stream bathes the intestinal mucosa, bicarbonate is secreted by the colonic epithelium in exchange for chloride (Cl⁻/HCO₃⁻ anion exchanger). Loss of alkali into the stool coupled with chloride accumulation results in normal anion gap hyperchloro-
As mentioned above, the expected acidosis in urinary–intestinal diversions is normal anion gap hyperchloraemic acidosis. The mixed acid–base pattern (hyperchloraemia and high anion gap) could in principle be explained by lactic acidosis or ketoacidosis (which were, however, excluded). The most plausible explanation of the abnormal anion gap was provided by the demonstration of a vesicoenteral fistula draining into a loop of the small intestine (while typically such fistulae drain into the colon). The increased duration of contact between intestinal mucosa and urine as well as the increased surface area exposed to urine promoted very high bicarbonate secretions by the colonic epithelium not matched by chloride accumulation, and facilitated a deleterious $\text{NH}_4^+$ reabsorption (which increased the blood acid load, and subsequently the measured anion gap). Furthermore, a loss of pancreatic alkali due to a washout effect of the diverted urinary flow may have contributed to the acidosis.

**Atypical clinical presentation**

Severe diarrhoea accompanied by life-threatening hyperchloraemic acidosis due to an enterovesical fistula is unique [5]. Signs and symptoms typical for enterovesical fistula, mostly vesicosigmoid, include irritable bladder symptoms, pneumaturia, faecaluria, and recurrent urinary-tract infections [6]. Fistula flow is typically intestine to bladder, thus accounting for the symptoms and signs. In the present case, an unusual combination of events led to the development of an opposite, atypical flow pattern. The radiation tissue injury resulted in compromised bladder integrity and fistulization. The previous abdominoperineal surgery facilitated juxtaposition of bladder and small intestine, resulting in the formation of the fistulous tract. The relatively low intraluminal pressure in the small intestine coupled with the high intravesical pressure of the bladder due to the chronic urinary retention led to the unique direction of flow from bladder to intestine.

**Atypical acid–base constellation: hyperchloraemic metabolic acidosis with high anion gap (present case)**

The presence of severe hyperchloraemic acidosis combined with an increased anion gap was initially difficult to explain.
Unexplained hyperchloremic hypokalaemic acidosis combined with high urea blood levels may suggest the presence of an urinary diversion into the gut, particularly in patients with a history of pelvic radiotherapy, surgery, or malignancy and concurrent bladder disorders.

References

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