

Acute Kidney Injury due to Sodium Bromate Intoxication: A Report of Two Cases

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Sodium bromate is a strong oxidant used as a neutralizing solution in hair permanents, as well as an auxiliary agent in printing and dyeing. Accidental or deliberate ingestion of bromate solution has rarely been reported in Korea. The clinical manifestations of bromate intoxication are vomiting, diarrhea, central nervous system symptoms, oliguric or non-oliguric acute kidney injury, hemolytic anemia, and deafness; most of these manifestations are reversible, with the exception of renal failure and deafness. Here, we report on two patients who demonstrated distinct clinical progressions. In the first case, a 16-year-old woman was successfully treated with hemodialysis and recovered renal function without hearing loss. However, in the second case, delayed hemodialysis resulted in persistent renal failure and hearing loss in a 77-year-old woman. This suggests that emergency therapeutic measures, including hemodialysis, should be taken as soon as possible, as the rapid removal of bromate may be essential to preventing severe intoxication and its sequelae.

Keywords: Acute kidney injury; Sodium bromate

INTRODUCTION

Sodium bromate is a strong oxidant that is widely used in hair permanents, as an auxiliary agent in printing and dyeing, and in many other chemical processes. In take-home cold wave hair permanent kits, the neutralizing solution typically contains 2–10% sodium or potassium bromate, which is colorless, odorless, and tasteless. If ingested, the clinical manifestations of bromate intoxication are vomiting, diarrhea, central nervous system symptoms, oliguric or non-oliguric acute renal failure, hemolytic anemia, and deafness [1,2]; all but kidney injury, and deafness are reversible. Although only gastrointestinal symptoms are typically observed in patients presenting with mild intoxication, renal disorders are frequently seen in patients

with severe intoxication [1,3,4]. Accidental or deliberate ingestion of hair neutralizer containing bromate has rarely been reported in Korea [5–8]; and there are no previous reports of bromate intoxication in an elderly patient in Korea. Here, we report two cases of bromate intoxication.

CASE REPORTS

Case 1

A 16-year-old female was referred to our hospital for management of bromate intoxication. She had been in good health until she ingested 75 mL of cold wave neutralizer in a suicide attempt. Within one hour of ingestion she developed nausea, vomiting, and diffuse abdominal

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pain. Upon arrival to the emergency room of another hospital, she received gastric lavage. During a second hospital admission, her urinary output decreased and she was referred to our hospital. Physical examination upon admission revealed the following: blood pressure, 100/60 mmHg; pulse, 92 beats/min; respiration, 16/min; and body temperature, 36.5°C. Laboratory tests showed the following: white blood cell count, 6,470/ μ L; hemoglobin, 10.2 g/dL; platelet count, 245,000/ μ L; serum sodium, 141 mEq/L; potassium, 3.7 mEq/L; chloride, 108 mEq/L; blood urea nitrogen, 39 mg/dL; creatinine, 9.4 mg/dL; bicarbonate, 24 mmol/L; glucose, 101 mg/dL; and amylase, 374 U/L. Liver transaminase levels were normal.

Urinalysis showed a specific gravity of 1.05, a pH of 6.0, and scores of 1+ for urine protein, and 3+ for blood. No casts or crystals were observed. On the second day of hospitalization, her daily urinary volume decreased to 600 mL. Hemodialysis was initiated and repeated every other day. On the seventh day, a percutaneous kidney biopsy was performed, which revealed no glomerular abnormality, but some renal tubules displayed degeneration and atrophy (Fig. 1). On the eleventh day, the patient's daily urinary volume increased to 1,300 mL and her serum creatinine level decreased to 2.3 mg/dL. Hemodialysis was halted, and the patient was discharged on hospital day 14 without hearing loss or other sequelae.

CASE 2

A 77-year-old woman was admitted to our hospital with nausea, vomiting, and abdominal pain. Her family

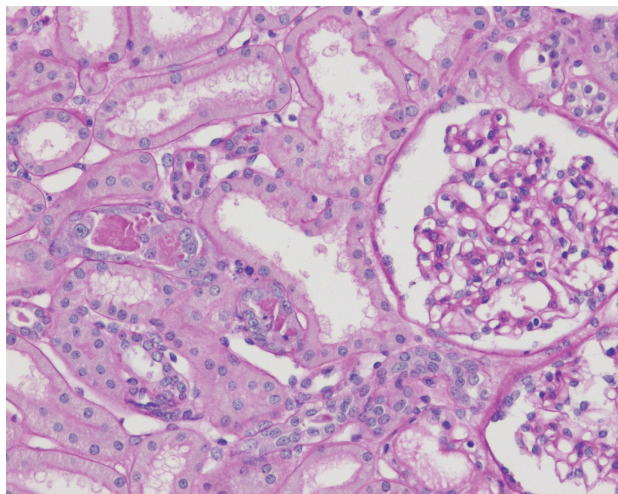


Figure 1. Light microscope findings. Percutaneous biopsy of the kidney shows degeneration of renal tubules and mild interstitial edema (H&E, \times 200).

members reported that, 15 hours earlier, she had ingested 100 mL of cold wave neutralizer (10% sodium bromate) in a suicide attempt. Upon admission, she appeared ill and physiological examination revealed the following: blood pressure was 115/75 mmHg, heart rate was 85/min, respiration rate was 18/min, and body temperature was 36.5°C. Serological testing was performed, and the results were as follows: white blood cell count, 10,020/ μ L; hemoglobin, 13.6 g/dL; platelet count, 225,000/ μ L; serum sodium, 146 mEq/L; potassium, 4.3 mEq/L; chloride, 106 mEq/L; blood urea nitrogen 27.39 mg/dL; creatinine, 3 mg/dL; bicarbonate, 21 mmol/L; amylase, 1,706 U/L; and lactate dehydrogenase, 1,310 U/L. Liver transaminase levels were normal.

Urinalysis revealed her urine chloride to be 119 mEq/L; she also showed scores of 3+ for urine protein and 1+ for blood. On the second day of hospitalization, her daily urinary volume decreased to 300 mL and she complained of hearing loss; pure tone audiometry confirmed sensorineural hearing loss. Hemodialysis was initiated and repeated daily for three days following, and then every other day. On the seventh day, the patient's serum amylase level had decreased to normal, but her hearing loss and daily urine output had not improved. On the eleventh hospital day, her daily urinary volume increased to 1,000 mL, but her serum creatinine level remained at 6.1 mg/dL. Hemodialysis was continued, but the patient died of septic shock on hospital day 104.

DISCUSSION

Bromate is an oxidizing agent that exists as a sodium or potassium salt. It is used in cold wave hair permanent kits, as a primary standard and brominating agent in analytical chemistry, and in the production of explosives. Permanent kits consist of two parts: the first is an ammonium thioglycolate solution that reduces keratin disulphide bonds to make hair more flexible; the second neutralizing solution contains bromate as an oxidizing agent to convert the sulfhydryl groups back to disulphide bonds to stabilize the new form of the hair [9]. Permanent wave kits still contain bromate in Korea, especially those for professional use.

Bromate is absorbed through the digestive organs and excreted in the urine, and bromate intoxication typically presents as the sudden onset of nausea, vomiting, abdomi-

nal pain, and diarrhea shortly after ingestion [1-3]. These gastrointestinal symptoms are probably due to the caustic action of hydrobromic acid, which is released when bromate reacts with gastric hydrogen chloride [9]. Bromate intoxication is also associated with acute renal toxicity, which may vary from mild and transient to severe anuric forms. However, the mechanism of renal damage is not yet understood. Proposed mechanisms include direct tubular toxicity due to the induction of active oxygen radicals and reduced renal perfusion resulting from intravascular volume depletion and, potentially, modulation of vasomotor tone [1,2].

It appears that children may overcome renal insufficiency without dialysis in many cases. This has been attributed to potential differences in the typical amount of bromate ingested, susceptibility to bromate and the related oxygen radicals in the renal tubules, and the relative potential for tubular regeneration among children, adults, and the elderly [9]. Severe irreversible sensorineural hearing loss, developing within 4–16 hours of ingestion, has been reported. The mechanism of bromate-induced ototoxicity has not been clearly delineated, although it is thought to be related to the dose ingested. Damage to the stria vascularis and degenerative changes in the outer hair cells of the cochlea have been described [10].

Treatment for bromate intoxication is largely empirical, commonly involving gastric lavage, renal replacement therapy, and specific therapies intended to promptly remove as much of the unabsorbed bromate as possible. Immediate gastric lavage should be performed, preferentially with 2% sodium bicarbonate to prevent formation of the irritating hydrobromic acid [9]. Administration of intravenous sodium thiosulphate may also help to reduce bromate to bromide [1,10]. Dialysis should be considered in every patient presenting within a few hours of ingestion of a significant amount of bromate. Although distinct, our cases show that emergency therapeutic measures, including hemodialysis, should be taken as soon as possible to

prevent severe intoxication and persistent loss of function.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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