CASE REPORT

A non-fatal intoxication with a high-dose sodium nitrate

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SUMMARY

A 67-year-old man accidentally ingested 75 g of sodium nitrate. He had instant gastrointestinal symptoms. On physical examination, he was respiratorily and haemodynamically stable and there were no signs of central or peripheral cyanosis. Repeated methaemoglobin levels were normal and he made an uneventful recovery. Sodium nitrate intoxication is rare. Serious effects can occur, mainly through formation of nitrite and nitric oxide, which can cause methaemoglobinaemia and vasodilation. Even if the presenting symptoms are mild, it is important to remain cautious since more serious symptoms can occur later. Monitoring of respiratory and haemodynamic status and repeated blood gas analysis in order to detect methaemoglobinaemia are recommended.

BACKGROUND

Sodium nitrate is a widespread substance in the environment and is used among others in the food industry. Intoxication with large amounts is rare and therefore information on clinical consequences is limited. This case adds to the current repertoire of knowledge regarding the effects of intoxication with sodium nitrate.

CASE PRESENTATION

A 67-year-old previously healthy man presented to the emergency department with acute nausea, profuse vomiting and diarrhoea which started a few minutes after he had accidentally ingested an aqueous solution (200 mL) of 75 g of sodium nitrate. The patient was supposed to have undergone an oral glucose tolerance test with dextrose monohydrate. Owing to the fact that the patient suffered instantaneously from gastrointestinal symptoms, there was doubt about the ingested solution and it was discovered that sodium nitrate was mistaken for dextrose monohydrate. There were no symptoms of headache or shortness of breath.

INVESTIGATIONS

On presentation to the emergency department, 4 h after ingestion, the patient was alert and not in respiratory distress. Oxygen saturation was 98% in room air registered by pulse oximetry and breath sounds were normal on auscultation. There were no signs of central or peripheral cyanosis. He was haemodynamically stable (blood pressure 135/85 mm Hg and heart rate 90 bpm). The abdominal examination was unremarkable, in particular, there was no hyperperistalsis. Laboratory examinations showed a normal blood gas analysis

(pH 7.44, partial pressure of carbon dioxide 4.5 kPa, partial pressure of oxygen 8.8 kPa, bicarbonate 23.1 mmol/L, base excess -0.4 mmol/L and arterial oxygen saturation 93%) and a methaemoglobin level of 1.8% (reference <3.0%). Other laboratory examinations were unremarkable.

OUTCOME AND FOLLOW-UP

Repeated blood gas analysis including methaemoglobin level after 7 h remained normal and observation over 24 h was uneventful. In the laboratory, comprehensive measures were taken to prevent substance confusion in the future.

DISCUSSION

Sodium nitrate (NaNO₃) is a colourless crystal or powder.¹ It is used among others in the food industry as a preservative, colour fixative and antimicrobial agent, mainly in cheese, meats and fish.^{1 2} Nitrate is also naturally present in the environment and in food, especially vegetables.^{2 3} The Joint Food and Agriculture Organization (FAO)/WHO Expert Committee on Food Additives have set an acceptable daily intake to a maximum of 3.7 mg nitrate ion (NO₃⁻) or 5 mg sodium nitrate/kg bodyweight.⁴

Fatal incidents after poisoning with sodium nitrite have been described, mainly due to severe methaemoglobinaemia.^{5 6} Less is known, however, about sodium nitrate intoxication in humans, and only a few cases have been reported so far.^{7 8} Toxicological data in rats showed a median lethal dose for 50% of participants after ingestion of 1270 mg/kg sodium nitrate.¹ Nitrate itself seems relatively non-toxic, but approximately 5% of all ingested nitrate is rapidly reduced to the more toxic component, nitrite, by bacteria in saliva and the gastrointestinal tract.^{2 3} Nitrite has a greater oxidative potential and therefore a greater ability to cause symptoms, mainly through formation of methaemoglobin.^{2 9} In addition, nitrite is a potent vasodilator¹⁰ and oral ingestion of inorganic nitrate may lead to the production of large amounts of nitric oxide (NO) in the acidic environment of the gastric lumen, which can also cause vasodilation and hypotension.^{2 9} Overall, oral ingestion of large amounts of sodium nitrate may cause headache, nausea, vomiting, diarrhoea, dyspnoea, bradycardia or tachycardia, hypotension, flushing and cyanosis due to methaemoglobinaemia.^{1 7 8} The lethal oral dose of potassium nitrate for an adult has been estimated to be between 4 and 30 g (about 40–300 mg NO₃/kg). Adults tolerate large doses of nitrate as sodium and ammonium salt

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(>100 mg NO₃⁻/kg) with only minor effects in some individuals (light methaemoglobinaemia, diarrhoea and vomiting).¹¹ These effects usually occur directly after ingestion, probably due to rapid absorption and transformation to nitrite.²⁻³ However, delayed effects have been described,⁷ possibly due to enterosalivary circulation of ingested nitrate and formed nitrite and continuous production of NO.⁹⁻¹⁰

Our patient ingested an extremely high dose of sodium nitrate of 833 mg/kg, which is far above the acceptable daily intake and had instant gastrointestinal symptoms. The patient's immediate and profuse vomiting may have prevented gastrointestinal absorption of large amounts of sodium nitrate and of the formed more toxic nitrite, since no serious effects like meth-

aemoglobinaemia or hypotension occurred. Although our patient made an uneventful recovery, it is important to remain cautious since more serious symptoms can occur later.⁷ It is therefore recommended to monitor respiratory and haemodynamic status in a high-dependency or intensive care unit for at least 24 h and to repeat blood gas analysis in order to detect methaemoglobinaemia.

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Competing interests None.

Patient consent Obtained.

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Learning points

- ▶ Sodium nitrate is a widespread substance in the environment, and in itself, contrary to potassium nitrate, seems relatively non-toxic. It should be taken into consideration however, that some amounts of nitrate can be converted to the more toxic component, nitrite, before or after reaching the human body, for example, by ingestion.
- ▶ Intoxication with high-dose sodium nitrate may cause only mild gastrointestinal symptoms, but more serious symptoms such as hypotension and cyanosis due to methaemoglobinaemia can occur (in the described case, those symptoms did not occur).
- ▶ After intoxication with sodium nitrate, monitoring of respiratory and haemodynamic status and repeated blood gas analysis in order to detect methaemoglobinaemia are recommended.

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