Case Report

Methemoglobinemia following ingestion of Indoxacarb: A case report

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Abstract

Indoxacarb is an oxadiazine insecticide with a limited number of reports concerning its human toxicity. We describe here the case of a 66-year-old male with methemoglobinemia following deliberate ingestion of Indoxacarb during an attempt at suicide. With early recognition of the cause and administration of methylene blue, rapid recovery was observed and the patient was discharged after only a short admission.

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Keywords: Indoxacarb; Intoxication; Methemoglobinemia

1. Introduction

Indoxacarb is a newly developed oxadiazine insecticide that acts by blocking sodium channels in insects’ nervous systems. However, information concerning its human toxicity is as yet limited. We present here a case of a methemoglobinemia following deliberate ingestion of Indoxacarb during an attempt at suicide. With rapid identification of the cause and early administration of methylene blue, this type of acutely intoxicated patient can be managed successfully with a good prognosis.

2. Case report

A 66-year-old male with a history of well-controlled lung cancer and chronic obstructive pulmonary disease was brought to our emergency department by his family. He had ingested about 100 mL of Indoxacarb insecticide (14.5% Indoxacarb, 6% related isomers, 79.5% inert ingredients and impurities) during an attempt at suicide 7 hours previously; the ingestion was followed by vomiting and diarrhea together with shortness of breath without choking.

On arrival, he was alert and oriented. His temperature was 37.8 °C, his pulse rate was 104 beats/minute, his respiratory rate was 20 breaths/minute, and his blood pressure was 120/60 mmHg. On physical examination, lip cyanosis and bilateral mild wheezing as a breathing sound were observed. The pupil size was 3.0 mm symmetrically, and both pupils had a good light reflex. The patient’s skin was dry. Oxygen was immediately supplied, and bronchodilator inhalation therapy was used. Vomiting, with the content having a pesticide odor, was noted at the emergency department, so activated charcoal was administered after gastric lavage in case there was delayed gastric emptying.

Laboratory examination disclosed a white cell count of 20.3 × 10^9/L, a hematocrit of 35.5%, a platelet count of 337 × 10^9/L, alanine aminotransferase of 25 IU/L, creatinine of 84.86 mmol/L, sodium of 137 mmol/L, potassium of 2.5 mmol/L, and serum pseudocholinesterase of 5664 U/L. An arterial blood gas analysis revealed a pH of 7.548, Paco_2 of 35.3 mmHg, Pao_2 of 35.3 mmHg and HCO_3^- of 31.0 mmol/L; the Sao_2 was 75.9% on an Fio_2 of 0.6. Based on these values, high-flow oxygen was supplied via a non-rebreathing mask.

Chest radiography showed bilateral exaggerated lung markings and a patchy lesion in the right lower lobe (Fig. 1). Hence empirical antibiotic therapy was initiated due to a suspected pulmonary infection. A follow-up arterial blood gas...
analysis showed a pH of 7.544, PaCO₂ of 37 mmHg, Pao₂ of 76.2 mmHg, HCO₃⁻ of 32.3 mmol/L, and Sao₂ of 93.6%.

The symptoms of dyspnea and cyanosis were partially improved after this initial management. However, respiratory distress developed soon after admission to the intensive care unit, and the lip and nail cyanosis became aggravated. A muddy brown color of the patient’s blood was also noted, so a blood sample was sent for analysis in order to determine the methemoglobin level, which was found to be very high, at 0.495 proportion of total hemoglobin. Methylene blue was immediately administered at a dose of 1 mg/kg intravenously. Within hours, the patient started gradually to show signs of improvement, and the SpO₂ increased to 86–89%. A repeated dose of methylene blue was infused, and the SpO₂ was improved further to 95–98%. When the methemoglobin was rechecked after the second dose of methylene blue, the level was found to have dropped to 0.032 proportion of total hemoglobin.

In addition, a psychiatrist was consulted in order to carry out a suicide risk assessment. The patient confessed to having been depressed lately; he also indicated that he felt guilty and had suffered from suicide ideation since a recent hospital admission due to pneumonia. His family members were informed and asked to monitor his mood. Psychiatric clinic follow-up was suggested because of an impression of adjustment disorder with a depressive mood. After one day of observation, the patient was transferred to a general ward in a stable condition, and he was discharged from hospital after 3 days.

3. Discussion

Indoxacarb, a member of the oxadiazine family of chemicals, is a newly developed insecticide (discovered in 1991 and registered in 2001) with high insecticidal activity and low toxicity against nontarget organisms. It acts on insects by blocking sodium channels in the nervous system and causes mild tremors, cessation of feeding, and death within a couple of hours. In animal studies, Indoxacarb has been shown to be a skin sensitizer in the guinea-pig, but is nonirritant to the skin or the eyes of rabbits; it was found possibly to cause hemolysis in subchronic studies. In our literature search, we found only a few case reports published in recent years describing methemoglobinemia following ingestion of Indoxacarb.

Methemoglobin is an altered state of hemoglobin in which the ferrous (Fe²⁺) ions of the heme are oxidized to the ferric (Fe³⁺) state. The ferric hemes of methemoglobin are unable to bind oxygen, and the oxygen affinity of any accompanying ferrous hemes in the hemoglobin tetramer is increased. As a result, the oxygen dissociation curve is shifted to the left, and oxygen delivery to the tissues is impaired. This condition most commonly results from toxic exposure. Some of the agents commonly implicated in this include nitrates and nitrites, local anesthetics, aniline products, and dapsone.

Most cases of methemoglobinemia are due to one of three processes: (1) the direct oxidation of ferrohemoglobin in the absence of oxygen, which involves the transfer of electrons from the ferrous heme to an oxidizing compound; (2) the indirect oxidation of ferrohemoglobin, a co-oxidation process that requires hemoglobin-bound oxygen and is involved, for example, in nitrite-induced methemoglobinaemia; and (3) biotransformation of a chemical into an active intermediate that initiates methemoglobin formation by a variety of different mechanisms. Methemoglobinaemia resulting from Indoxacarb intoxication seems to involve the third pathway since the metabolism of Indoxacarb probably involves the cleavage of the parent compound and the production of aniline metabolites, aromatic compounds that are able to produce methemoglobin by metabolism.

Treatment of methemoglobinaemia depends upon the clinical setting. Patients in shock may benefit from a blood transfusion or an exchange transfusion. In patients with a lesser degree of methemoglobinaemia, no therapy other than discontinuation of the offending agent may be required. However, a methemoglobin level about 0.25–0.3 proportion of total hemoglobin can cause acute hypoxia. If the patient is symptomatic, which is often the case in deliberate or accidental overdoses or toxin ingestion, specific therapy is indicated. The treatment of choice is methylene blue. It is administered typically in doses of 1–2 mg/kg of body weight intravenously over 5 minutes. The response is usually rapid. Repeat doses may be indicated if the symptoms persist.

4. Conclusion

In this case, we provide our experience when managing a case of methemoglobinaemia following deliberate ingestion of Indoxacarb. Fortunately, the patient was successfully treated with methylene blue before catastrophic results had occurred.
This case report highlights the importance of considering the possibility of methemoglobinemia in cases of exposure to Indoxacarb and its early recognition and management.

Conflict of interest

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and / or company that could be construed as influencing the position presented in, or the review of, the manuscript entitled “Methemoglobinemia following ingestion of Indoxacarb: A case report.” Ping-Chih Shih, Tsung-Hsien Tsai.

References