CASE REPORT

Indoxacarb Toxicity: Treat the Patient, Not the Monitor

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Received on: 28 October 2022; *Accepted on:* 16 January 2023; *Published on:* 07 March 2023

Abstract

Introduction: Here, we report the successful management of indoxacarb poisoning resulting in methemoglobinemia (MetHb) in a young female. Previously published literature has revealed the pathophysiology and occurrence of MetHb after indoxacarb ingestion requiring high oxygen therapy for treatment.

Case description: A 25-year-old female presented with indoxacarb poisoning, resulting in MetHb. She was managed on room air despite the low saturation shown on pulse oximetry. She also received treatment with methylene blue (MB) and vitamin C. The patient recovered completely and was shifted to the ward.

Conclusion: Through this case report, we want to highlight the lacunae in managing indoxacarb toxicity. We suggest that in-depth knowledge of the pathophysiology of indoxacarb toxicity and clinical observations are quintessential before the initiation/continuation of oxygen therapy in such cases. We also emphasize the importance of detailed history taking before initiating treatment with a drug like MB.

Keywords: High-flow oxygen, Indoxacarb, Methemoglobinemia, Methylene blue

Indian Journal of Critical Care Case Report (2023): 10.5005/jp-journals-11006-0038

Introduction

Indoxacarb is a component generally seen in insecticides, primarily as oxadiazine, the mechanism of action being blockage of the sodium channel in the insects' nervous system, leading to impaired nerve conduction, paralysis, and death. Accidental or intentional exposure has been reported in humans *via* oral and physical contact, during preening and at rewetting surfaces.[1] However, oral ingestion is potentially toxic as the lethal dose (LD) 50 is 1800 mg/kg, whereas the dermal LD 50 is >5000 mg/kg.[2] We report the management of a patient with MetHb who presented with ingestion of indoxacarb in a suicidal attempt.

Case Description

A 25-year-old married female weighing 50 kg presented to the emergency with complaints of vomiting, dizziness, and peripheral cyanosis. History elicited from relatives revealed that the patient had ingested an insecticide, "INDOKING" (indoxacarb—14.5%) 8 hours ago in an attempted suicide, after which she was immediately taken to a local hospital where gastric lavage was performed. The patient was referred to a higher center for further management. On arrival, her oxygen saturation (SpO_2) was low; 80% on room air and 82% on a non-rebreathing mask (NRBM) at 12 L/minute. However, the patient's vitals were stable, with no respiratory distress, and she was fully conscious and oriented. Arterial blood gas (ABG) revealed—pH 7.36, partial pressure of oxygen (PaO_2)—342.3, partial pressure of carbon dioxide ($PaCO_2$)—30.8, bicarbonate (HCO_3)—17.2, Na/K-147.4/4.17, MetHb-54.7%, oxyhemoglobin (O_2Hb)—45.1, and lactate-1.19 (Table 1). The patient was started on vitamin C infusion @150 mg/hour, following which she was immediately transferred to the adult intensive care unit (AICU) for further management. On receiving AICU, her saturation was 84% on 15 L/minute NRBM. However, the patient was not cyanosed, tachypneic, or neurologically compromised and was hemodynamically stable. The oxygen therapy was immediately discontinued in the AICU, and SpO_2 was continuously monitored, which remained the same.

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How to cite this article: Yadav S, Sharma A. Indoxacarb Toxicity: Treat the Patient, Not the Monitor. Indian J Crit Care Case Rep 2023;2(1):17–18.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

The arterial line was secured for hemodynamic monitoring. A short history of recurrent jaundice, easy fatiguability, passing frequent dark urine, and psychiatric medication intake was elicited, which yielded a negative response. This helped us to rule out any associated glucose-6-phosphate dehydrogenase deficiency (G-6-PDD) before initiating the antidote MB. A bolus of 100 mg MB was given intravenously over 10 minutes, following which her SpO_2 levels increased to 98% in 15 minutes. The repeat ABG on room air showed—pH–7.35, PaO_2–85.3, $PaCO_2$–27.7, HCO_3–015.1, Na/K–0145.5/3.19 MetHb–1.9 %, O_2Hb–94, and lactate–0.38 (Table 1). Subsequently, MB continued at 50 mg twice daily, and vitamin C was converted to an oral tablet of 500 mg thrice daily. ABG was done twice daily, and lab investigations were repeated in the AICU. Her laboratory value was mostly unremarkable except for the slight rise of creatinine from 0.86 to 0.93. Vitamin C was continued, but MB was stopped on day 3 after a psychiatric evaluation was done. She was shifted to the ward with stable vitals and advised to monitor the kidney function test and urine output.

Table 1: Baseline ABG showing MetHb and ABG after administration of the first dose of MB

ABG parameters	*Baseline ABG on NRBM (O_2 flow rate 12 L/ minute)*	*After administration of the first dose of MB on room air*
FiO_2	0.70	0.21
pH	7.36	7.35
PO_2 (mm Hg)	342.3	85.3
PCO_2 (mm Hg)	30.8	27.7
SaO_2 (%)	99.8	97.0
HCO_3 (mmol/L)	17.2	15.1
BE (mmol/L)	−7.2	−9.3
Na (mmol/L)	147.4	145.5
K (mmol/L)	4.17	3.19
Hb (gm/dL)	10.11	8.71
MetHb (%)	**54.7***	**1.9***
COHb (%)	0.1	1.1
O_2Hb (%)	45.1	94.0
Glucose (mg/dL)	101.8	86.7
Lactate (mmol/L)	1.19	0.38

ABG, arterial blood gas; BE, base excess; COHb, carboxy-hemoglobin; Hb, bemoglobin; MetHb, methemoglobinemia; NRBM, non-rebreathing mask; O_2Hb, oxy-hemoglobin; PCO_2, partial pressure of carbon dioxide; PO_2, partial pressure of oxygen; *Significant reduction in MetHb after administration of methylene blue

The patient provided written informed consent for the publishing of this case report.

Discussion

The basic pathophysiology of MetHb is the increased affinity of hemoglobin (Fe^{3+}) to bind to oxygen leading to the left shift of the oxygen–hemoglobin dissociation curve, causing reduced delivery of oxygen to tissue, also known as functional anemia. In such cases, pulse oximetry is unreliable because of the typical light absorption spectra of MetHb.[3] In such cases, CO-oximetry or ABG should be used as a guide for oxygenation. By understanding the pathophysiology, we realize that increasing oxygen in the blood will not treat the disease. In the coronavirus disease 2019 pandemic, where oxygen is a limited resource, we should use it judiciously to tide over the crisis. As we saw in this case, the saturation remained the same even after withdrawing oxygen therapy. Oxygen therapy should be reserved for patients who develop respiratory distress with neurological symptoms.

Normal MetHb levels are <1%, whereas levels >60% are fatal.[4] We should focus on reducing the exposure and providing an antidote as soon as possible. MB (1–2 mg/kg) and vitamin C (1–1.5 gm/day in infusion) are reducing agents for converting MetHb to standard form *via* nicotinamide adenine dinucleotide phosphate reductase. However, the onset of action in MB is much faster than in vitamin C, so it remains the agent of choice unless contraindicated.[5] Before initiating MB, proper history regarding G-6-PDD should be elicited, as administration in such patients can cause hemolysis. Also, patients on serotonergic drugs can have symptoms of serotonin syndrome if they receive MB because MB is a monoamine oxidase inhibitor.[6]

Jin reported that propylene glycol, an additive in indoxacarb, can lead to nephrotoxicity even after MetHb has been corrected.[7] Hence, patients should be continuously monitored for signs of acute renal failure.

Conclusion

Patients with indoxacarb poisoning should be monitored in the intensive care unit, and unnecessary oxygen supplementation should always be avoided. Further case series or prospective observational studies are required to validate these findings.

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