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Case Report

Iatrogenic pediatric hydroxocobalamin overdose☆

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ABSTRACT

Introduction: Hydroxocobalamin, a precursor molecule to vitamin B12, has emerged as the preferred empiric treatment for patients rescued from enclosed-space fires with concern for inhalational injury and potential concomitant cyanide toxicity. Limited data exist on the effects of hydroxocobalamin toxicity, particularly in pediatric patients.

Case report: We report a case of a healthy three-year old girl who was rescued from an apartment fire and electively intubated by prehospital providers. Due to concern for potential cyanide toxicity, she received 5 g (373 mg/kg) of intravenous hydroxocobalamin, an amount equivalent to one standard adult dose but over five times the appropriate weight-adjusted dose for this 13.4-kilogram child. On hospital arrival, patient was noted to have chromaturia and diffuse erythroderma without cutaneous burns. She was extubated 4 h after prehospital intubation and discharged home the following morning in good condition with persistent erythroderma. Skin color returned to normal within two days.

Discussion: We believe this to be the first reported case of iatrogenic pediatric hydroxocobalamin overdose for the treatment of suspected cyanide toxicity. Erythroderma and chromaturia are expected side effects of hydroxocobalamin, even at therapeutic levels. Along with minor airway burns, the only other finding was a transient and hemodynamically neutral bradycardia, which began shortly after prehospital intubation. As this bradycardia occurred prior to hydroxocobalamin administration, more likely culprits include vagal nerve stimulation from direct laryngoscopy, and sinoatrial muscarinic receptor stimulation caused by repeated doses of succinylcholine. In all, we were unable to appreciate any complications due to excess hydroxocobalamin administration.

1. Introduction

Hydroxocobalamin, a precursor molecule to vitamin B12, has emerged as the preferred treatment for patients with known or suspected severe cyanide toxicity [1]. Hydrogen cyanide is an inhalational toxicant often found in structure fires due to incomplete combustion of nitrogen-containing materials such as nylon, plastic, wool, or silk [2]. Due to this potential exposure, many emergency medical service (EMS) systems empirically treat patients rescued from enclosed-space fires with concern for inhalational injury and potential concomitant cyanide toxicity [1]. However, limited data exist on the effects of hydroxocobalamin toxicity, particularly in pediatric patients.

2. Case report

A healthy three-year-old girl was rescued by firefighters from an apartment fire. She was breathing and moving all extremities without signs of cutaneous burns, but paramedics electively intubated the child after finding soot around the nose and mouth. The patient received etomidate and three weight-adjusted doses of succinylcholine during the intubation, followed by midazolam and fentanyl for post-intubation sedation. She also received 5 g (373 mg/kg) of intravenous hydroxocobalamin given concern for potential cyanide toxicity, an amount equivalent to one standard adult dose but over five times the appropriate weight-adjusted dose for this 13.4-kilogram child [3].

On emergency department (ED) arrival, her vital signs were: temperature 35.9 °C, heart rate 54 bpm, blood pressure 111/83 mm Hg, respirations 26 per min, and pulse oximetry 99% on 100% oxygen by bag-valve mask. Her exam was notable only for chromaturia and diffuse erythroderma, thought to be secondary to hydroxocobalamin administration. A co-oximetry panel was sent but could not be analyzed by the laboratory due to an "interfering substance," likely cyanocobalamin. She was subsequently admitted to the pediatric intensive care unit without incident.

The patient's bradycardia resolved without intervention after 2 h, and bronchoscopy revealed a small number of carbonaceous deposits in the proximal bronchi, consistent with grade 1 inhalational injury. She was extubated approximately 4 h after time of prehospital intubation and observed overnight without incident. The following morning, she was discharged in good condition with persistent erythroderma.

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Skin color had returned to normal at time of telephone follow-up two days later.

3. Discussion

We believe this to be the first reported case of iatrogenic pediatric hydroxocobalamin overdose for the treatment of suspected cyanide toxicity. The patient developed erythema and chromaturia, both of which are expected even with therapeutic levels of hydroxocobalamin [4]. Along with minor airway burns, the only other abnormal finding was a transient and hemodynamically neutral bradycardia, which occurred shortly after prehospital intubation. Interestingly, this was also the time at which the prehospital hydroxocobalamin infusion was initiated.

Given the multitude of simultaneous therapeutic interventions in this unstable pediatric patient, the cause of the transient bradycardia is likely multifactorial. Bradycardia is a common occurrence during intubation of critically ill children, often due to a variety of factors [5]. Direct laryngoscopy is known to stimulate efferent vagus nerves in the laryngopharynx. Pediatric patients also suffer disproportionate vagus nerve stimulation in response to hypoxia, a common occurrence in the peri-intubation setting. Succinylcholine is also known to cause sinus bradycardia via agonism of sinoatrial muscarinic receptors, the risk of which is significantly increased with repeat succinylcholine administration [6,7].

With regards to hydroxocobalamin, hemodynamic effects have been seen when administered to healthy adult volunteers [4,8]. In two separate studies, healthy volunteers receiving therapeutic doses of hydroxocobalamin experienced transient hypertension accompanied by reflex bradycardia. Among both trials, systolic blood pressure rose an average of 13–16%, while heart rate decreased by an average of 16%. These hemodynamic changes were noted to be clinically asymptomatic, and generally resolved within 1–4 h. This closely parallels the initial bradycardia and mild hypertension seen in our patient, both of which normalized over several hours. While the degree of bradycardia was more severe than previously observed with healthy adult volunteers, it may not be appropriate to apply those data to a pediatric patient undergoing emergent intubation. Similarly, the observed bradycardia was clinically silent, without evidence of impaired end-organ perfusion.

In sum, while this young child suffered an iatrogenic hydroxocobalamin overdose during the treatment of suspected cyanide toxicity, she rapidly recovered without life-threatening complication or serious adverse effect.

Conflict of interest

The authors report no conflicts of interest.

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