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Case Report

Nebulized ketamine to avoid mechanical ventilation in a pediatric patient with severe asthma exacerbation

Abdelghafour Elkoundi *, Aziza Bentalha, Alae El Koraichi, Salma Ech-Cherif El Kettani

Pediatric Intensive Care Unit, Children Hospital of Rabat, Faculty of Medicine and Pharmacy of Rabat, University Mohammed V, Rabat, Morocco

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ABSTRACT

Asthma is a major cause of morbidity and mortality despite advances in outpatient treatment. Sometimes, children fail to respond to standard treatment and can potentially require mechanical ventilation.
We describe a case of a 26-month-old girl with a severe asthma exacerbation successfully managed by ketamine administration via nebulization route that permitted to avoid mechanical ventilation. Nebulized ketamine might be a reasonable option to avoid mechanical ventilation in children who fail to respond to standard treatment of severe asthma exacerbation.

1. Introduction

Asthma is the most common chronic disease of childhood and is a major cause of morbidity and mortality despite an improved understanding of the pathophysiology and advances in outpatient treatment. Sometimes, children with asthma have the potential to deteriorate into respiratory failure requiring mechanical ventilation. This case suggests that nebulized ketamine may be an effective and promising measure to avoid mechanical ventilation in case of severe asthma exacerbation refractory to standard treatment.

2. Case presentation

A 26-month-old girl (weight 15 kg) was admitted to emergency room with respiratory distress, chest discomfort, and wheezing. The preceding night, her mother noted a severe cough, runny nose, and audible wheezing. Despite the use of inhaled albuterol at home, she continued to have labored breathing. At aged 8 months, she presented bronchiolitis for which she was admitted to the pediatric ICU. Her medical history was also remarkable of an episode of acute wheezing responsive to albuterol, at aged 12 months.

On admission, the patient displayed marked accessory muscle use, was tachypneic and tachycardic and had an oxygen saturation of 90% on room air with a normal temperature. She received three doses of albuterol 2 mg and ipratropium bromide 250 μg for an hour duration via a nebulizer device, as well as intravenous (IV) methylprednisolone (2 mg/kg/24 h). She had become less responsive; oxygen saturation was only 92% on high-flow oxygen (10 l/min), and chest auscultation revealed minimal bilateral air entry along with increased wheeze. Two IV bolus doses of albuterol (15 μg/kg), as well as a bolus dose of sulfate magnesium (50 mg/kg), were administered without clinical improvement.

The anesthetic staff was involved. Arterial blood gases showed pH 7.29; pCO_2 68; pO_2 96; HCO_3 26; and oxygen saturation of 91%. Continuous ketamine IV was discussed, but given the concern of prolonged time to take effect, it was decided to attempt ketamine nebulization as a last resort concomitantly with preparing the patient for a possible rapid sequence intubation.

The patient's parents were explained about the procedure and its possible side effects (particularly psychedelic effects) for what they expressed confidence with the staff choice. We administered ketamine 1 mg/kg by mean of the nebulizer device and were aware of any sign of further clinical deterioration indicating that mechanical ventilation is inevitable. Twenty minutes after starting nebulized ketamine, the patient's respiratory status markedly improved, as evidenced by fluent air entry and minimally audible wheezing on chest auscultation. No side effects of ketamine were noted. Blood gas analysis showed marked improvement: pH of 7.33, pCO_2 of 37, pO_2 of 250 and HCO_3 of 22. Thereafter, a second bolus of nebulized ketamine was administered. The patient's condition further improved; respiratory distress and wheezing were relieved, and oxygen saturation level increased to 98%. She was maintained on continuous nebulized albuterol for two more hours. She did not experience any exacerbation overnight and was discharged from hospital 48 h later.

3. Discussion

Children are frequently admitted for acute asthma exacerbation in the emergency department. In some cases, standard regimens

* Corresponding author.
E-mail address: abd.el.koundi@gmail.com (A. Elkoundi).

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treatment fails and mechanical ventilation is required which exposes the patient to substantial iatrogenic risks.

Ketamine has been proven over many years to be safe, effective and particularly attractive as an IV, intramuscular or intrarectal agent for procedural sedation and analgesia in children. Although the use of ketamine IV for the treatment of severe asthma exacerbation has been shown in case reports and observational studies to improve outcome and preventing mechanical ventilation [1-3] it has been limited by the risk of adverse effects [4].

Different reports of nebulized ketamine have suggested that this route of use is both effective and plausible for various situations [5-8]. Advantages include rapid delivery and absorption into the systemic circulation and the possibility of administration without the need of IV access line. However, the use of nebulized ketamine for treatment of asthma in humans has never been investigated. In a murine model of reactive airway disease, Zhu et al. studied the effect of ketamine inhalation on bronchial hyperresponsiveness and airway inflammation. As confirmed by lung histological examination, Th2 cytokine levels and total and differential cell counts in the broncho-alveolar lavage fluid, it was demonstrated that nebulized ketamine inhibits the cascade of inflammation and reduces markers of inflammation [9].

The mechanism of effect in this case is possibly the topical effect of ketamine nebulization that attenuated the local inflammation, but also the systemic effect of ketamine. Besides, the respiratory effects of ketamine bronchodilation are noticeable [10], which may have some salutary role in the rescue of such acute asthmatic patient. It is also plausible that the systemic effect of ketamine induced anxiolysis and a decrease in the mechanical load breathing without compromise of the respiratory drive. Conceivable mechanisms of actions are the diminution of the resistive component of the work done by the chest musculature and a reduction of the respiratory rate, thus increasing the time available for exhalation. Finally, ketamine may have provided time for standard therapies to take effect, and thereby obviate intubation.

4. Conclusion

The uncommon use of nebulized ketamine in this case indicates that this route might be a promising option in the management of severe asthma exacerbation in children. Certainly, additional studies are required to better determine the efficacy of nebulized ketamine in this indication.

Ethics approval and consent to participate

Not applicable.

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Authors' contributions

AE drafted the manuscript under the supervision of AEK and AB. AEK, AB and SE-CEK contributed in collecting data and critically revised the manuscript. All authors gave their final approval of the version to be published. They all participated in patient care.

Competing interest

All authors declare that there are no conflicts of interest.

Consent for publication

Written informed consent was obtained from the patient's parents for publication of this case report.

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