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Case Report

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Ketamine Therapy in an Adolescent Patient at 35 Weeks of Gestation With Status Asthmaticus

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Abstract

The patient was a 15-year-old female gravida 1 para 0 (G1P0) presenting to the emergency department (ED) with a chief complaint of shortness of breath. Her fetus had an estimated gestational age (EGA) of 35 weeks, dated by first trimester sonography. Her past medical history was significant for asthma and suicide attempts via drug overdose. On inspection, the patient was tripoding and was given standard management protocol of nebulizer and albuterol treatments to address her asthma exacerbation. A few hours after treatment, the patient progressed to status asthmaticus and was rushed to the intensive care unit (ICU). She was intubated at that time to address her extreme respiratory acidosis. Sedation was provided with ketamine, which is also occasionally used to address status asthmaticus in refractory patients, regardless of pregnancy status. The use of ketamine in status asthmaticus is still questionable in efficacy. Given that she was under the age of 18, she was transferred to a facility more capable of handling a pediatric ICU and probable future neonatal ICU patient. The patient was transferred to Texas Children's Hospital (TCH) via helicopter, where she was given repeat dosage of ketamine during her air travel. The patient later developed late decelerations, which required emergent primary cesarean section, at which time infant was born with Apgar scores of 1, 2, and 2. The patient was gradually weaned off the ventilator over about 1 week. She was discharged about 1 - 2 weeks later from TCH with several medications to address her asthma and prevent future attacks of this magnitude.

Keywords: Asthma; Anesthesia; Ketamine; Pregnancy

Introduction

This case report highlights the use of ketamine during a patient's episode of status asthmaticus which has been used in refractory cases of status asthmaticus. The interesting discussion point in this case is its use in the third trimester for a pediatric pregnant patient. While asthma is an extremely prevalent condition, status asthmaticus is a relatively uncommon complication in the asthmatic population. Its incidence in pregnancy varies by geographical area, but combining the two demographics, there are many cases reported. The message we hope to convey in this case report is the possible use of ketamine in emergent situations of intubation should be considered, even in the pregnant population.

Case Report

The patient arrived at the emergency department (ED) complaining of difficulty breathing but was awake, alert, and oriented to name, date, and location. Upon arrival, the obstetrics (OB) team was consulted since she was in her third trimester with an estimated gestational age (EGA) of 35 weeks and the fetus was found to be in stable condition. Clinical respiratory score obtained by the OB was 3. The patient was observed to be in a "tripod" positioning, which suggested serious difficulties with breathing. This led to administration of both albuterol and nebulizer treatments in attempt to restore patient to normal breathing. The patient was transported to the antepartum ward from the ED for continued treatment, where she complained of a constant back and abdominal pain leading to administration of a 2 mg dose of morphine. Arterial blood gas (ABG) results in antepartum showed pH of 7.42, oxygen partial pressure (pO_2) of 69, carbon dioxide partial pressure (pCO_2) of 31 and a bicarbonate of 20. Though management and monitoring of patient continued, a code green was called due to the patient's excessive difficulties with respiration.

Upon initial inspection, the patient was in acute respiratory distress, hyperventilating, and using accessory muscles of inspiration. Short expiration times were noted, and the patient was instructed to decrease her respiratory rate. The patient's tone was tense, and her eyes were rolled backed. Upon questioning the patient's grandmother in the room, the grandmother stated that the patient has known allergies to "animals" and that there was a history of shortness of breath for 2 - 3 days preceding this visit. Repeat ABG after apparent status asthmaticus showed a new pH of 7.23, pO_2 of 558 (due to 100% fraction of inspired oxygen (FiO_2) following intubation), pCO_2 of 46, and a bicarbonate of 19.

A quick review of her records revealed three visits during

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a 6-month period for breathing-related issues. Cumulatively, she had seven visits to the ED for asthma exacerbations in the past 6 years. Her most recent previous visit to the ED was for a chief complaint of shortness of breath 4 months prior, for which she was treated with nebulized albuterol, Decadron phosphate injection, nebulized ipratropium, then discharged after observation. She was 5 months pregnant at this visit.

She had prior documented suicidal ideation, for which she was admitted from the ED 13 months prior to this encounter. At that time, the patient stated she ingested 13 pills of tramadol on a Sunday and presented to the ED on the following Wednesday. She also told the physician she had "no real ill effects" from this suicide attempt. Urine drug screen upon admission was negative for all drugs or drug metabolites. She admitted to other suicide attempts and upon further interviewing, the care team noted a tumultuous relationship between the patient and her mother. Moreover, she admitted to thoughts of hurting her mother to the attending physician at her ED visit. She has a history of multiple psychiatric inpatient treatments due to bipolar depression. She denied any drug use but admitted to tobacco use (via vaping) at that time. She was then brought to a psychiatric treatment facility for treatment of her recurrent suicide attempts. This was not the only episode of the aforementioned suicide attempt. Attempts date back to just under 2 years prior to her arrival to the ED today. Eight Midol pills were ingested, and an unknown number of unknown pills were taken in an attempt to take her own life.

During a prior visit for shortness of breath, at a self-reported 9 weeks of EGA, she admitted to a history of anxiety for which she was medicated. She said medications were discontinued following her exit from the preceding admission to a psychiatric treatment facility. Interestingly, the physician during this encounter believed her shortness of breath to be more psychiatric in nature, giving a primary diagnosis of anxiety reaction and even giving a dose of lorazepam to the patient, in addition to Duoneb and Decadron. At this visit, she also admitted to drinking socially. Interestingly, the current medications listed on this patient's visit for this encounter differed from the one about 7 months earlier. This includes a lack of montelukast, trazadone, escitalopram oxalate, loratadine, and aripiprazole. The question arises of whether she discontinued her montelukast and loratadine, either self-initiated or physician recommended, or if it was simply not mentioned during her visit. Urine drug screen was not taken upon admission of the patient on initial presentation to the ED, thus we cannot rule out possible drug overdose.

Discussion

Ketamine is an N-methyl-D-aspartate (NMDA) receptor antagonist which is primarily used for its somnolent effects. NDMA receptors are excitatory by nature and receptor antagonism will lead to an inhibitory effect that provides a sedative effect in patients who undergo drug administration. It has garnered attention over the past few years due to its rising popularity as a recreational drug with psychotropic effects. Currently, this causes hesitancy with some providers, especially with the pregnant population. In the psychiatric field, however, the drug has promising possibilities as an option for specific depression cases. These patients are monitored closely and are refractory to multiple treatment modalities.

It is a unique drug in that it does not cause the side effects of decreased respiratory efforts or hypotension and is therefore commonly used for hypovolemic patients such as in cases of severe trauma wounds [1]. It has also been efficacious in patients with major depressive disorder refractory to other treatments. However, it is not commonly used medically in settings other than emergent analgesic use.

Because of the widespread stigma around ketamine use, it has not been commonly used in pregnant women as a sedative. However, there are some studies that have shown its effect on the developing fetus as well as the mother. A 2014 study done on rats in the second trimester of pregnancy showed that ketamine was neurotoxic to the developing brain [2]. Specifically, the experimental group of mice developed depressed and anxiety-like behavioral disorders with decreased abilities to store memories compared to the control group [2]. The researchers hypothesized that this was due to a hindrance upon the regulation of necessary proteins in the hippocampus that promote homeostasis [2].

Because few studies have been conducted looking at the safety of ketamine use in the pregnant patient, ketamine has not been placed into a pregnancy risk category by the Food and Drug Administration (FDA) [3]. However, it has been demonstrated that there is passage between mother and fetus of ketamine in utero [3]. Lack of evidence is a significant deterrent for many practitioners considering the implementation of a particularly ostracized drug.

Ketamine use in asthmatic patients has remained questionable. While not a primary treatment for patients with asthma for prophylactic use, it has seen rising popularity in use for status asthmaticus patients, or those with severe asthma. A recent review done in 2013 showed that when ketamine is added to standard management of asthma, patients are proven to have better outcomes and are less likely to need ventilation [4]. Moreover, this can also be said for pediatric patients. In 2016, another review of ketamine specifically used for childhood severe asthma showed that the drug is reasonable to administer in patients who are refractory to primary treatment [5]. Furthermore, this provides a less invasive option as compared to intubation and mechanical ventilations.

In a 2023 article discussing the vast modalities available for patients with status asthmaticus during pregnancy, it was written that ketamine generally provides a useful option to providers needing induction for intubation [6]. Moreover, it has a fairly good outcome in these critically asthmatic patients [6]. The treatment was specifically recommended in this review to be used in patients that were refractory to other treatments acutely.

Status asthmaticus as a condition is particularly dangerous, and this is even more true in the pregnant state. It is described as a form of asthma that is not responsive to multiple treatments of inhaled beta agonist treatments [6]. Patients are initially managed with these inhalation treatments and possibly steroids and/or leukotriene therapy. If disease worsens, patients may become so critical that they require in-

tubation. Status asthmaticus is a particularly dangerous condition as patients fatigue easily and may develop respiratory compromise. When caring for a gravid patient with status asthmaticus, goals for management are specific. It is important to maintain oxygen levels at an appropriately high level (94-98%), as decreasing saturation below this runs the risk of fetal hypoxia and poor outcomes [6]. Early recognition and management confer the best results in treatment of acute status asthmaticus [6].

Our patient was unique in that she was not only a pediatric patient with a history of refractory depression but was also gravid in the setting of acute status asthmaticus. The various co-morbidities presenting in this patient (status asthmaticus, pregnancy, teenage patient, history of suicide attempts) makes this an intriguing clinical presentation and management conundrum. This is the reason why this patient is particularly important to learn from.

Conclusions

The patient was helicoptered to a higher acuity facility where a cesarean was performed the following morning and was resting in stable condition. She was given 1 mg/kg every 10 min of ketamine in flight on her way to this hospital. Approximately 12 h after being transferred, she developed late decelerations which was cause for emergent cesarean section. Newborn was born, with Apgar scores of 1, 2, and 2. A week later, the child was stable in the neonatal intensive care unit (ICU), receiving bottle feeds. The patient was gradually weaned off her ventilator and was ultimately extubated about 1 week later. She was treated with intravenous solumedrol and albuterol. She did have symptoms of aphonia post extubation, which had improved with speech therapy. Transitioned to Dilaudid/clonidine wean after extubation. Prescriptions on discharge given by the consulting pulmonologist included Symbicort two puffs twice daily (BID), montelukast 10 mg daily (QD), Claritin 10 mg QD, Flonase BID, albuterol four to six puffs as needed (PRN).

While the patient seemed to respond well to ketamine during an episode of status asthmaticus demonstrating its safe and efficacious use during pregnancy in this specific instance, research is still limited. There are promising advancements being made assessing the risk/benefit profile of ketamine in asthma, depression, and pain management. Ketamine appears to be an effective tool in the management of status asthmaticus. It appears that there is no extenuating threat to the health of the mother or child at EGA 35 weeks. Follow-up studies with this patient should be conducted to determine the impact, if any, on her child's development.

Learning points

Ketamine use in a pregnant patient should still be considered an option when in need of a solution in the setting of status asthmaticus.

Urine drug screen should be a consideration for inclusion with lab work in a pregnant patient presenting with history of drug use or suicide attempt.

Severe asthma is a pertinent portion of the past medical history of a patient and should be noted in the paperwork of OB and gynecology specialists.

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None to declare.

Financial Disclosure

None to declare.

Conflict of Interest

None to declare.

Informed Consent

Verbal informed consent to use this case presentation as a case report publication was obtained from the patient.

Author Contributions

Manuscript preparation assistance: Armand Tadjali and Matt Smithhart. Armand Tadjali (50%) as primary author was involved in direct patient care and created the working draft for this case report. Matt Smithhart (40%) as secondary author (formatting) critically reviewed the study and edited the manuscript as needed. Dr. Hector Chapa (5%) as PI provided direct patient care. Dr. Robert Pope (5%) as PI provided direct patient care.

Data Availability

The authors declare that data supporting the findings of this study are available within the article. Additionally, the medical data were located within the treating hospital's electronic medical record (Meditech); any other data desired supporting the findings of this study are available from the corresponding author upon reasonable request.

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