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CASE REPORT

A Case of Resistant Status Asthmaticus: Resistant to Steroids and Responsive to IV Epinephrine

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Introduction

Status Asthmaticus, is a medical emergency, an extreme form of asthma exacerbation characterized by hypoxic and hypercapnic respiratory failure with resistance to standard therapy including inhaled selective beta-adrenergic agonists, low dose systemic steroids and usually responds to high dose systemic steroids with continuous nebulization of bronchodilators. Epinephrine, while not significantly advantageous in cases of mild to moderate asthma compared to standard therapy, can be significantly useful in cases of resistant, life-threatening asthma. Here, we present a case of Status Asthmaticus involving a patient in an ICU setting who did not respond to aggressive nebulization treatment, high-dose steroids, and ketamine therapy. However, the patient ultimately responded to a continuous infusion of IV epinephrine and eventually was able to be extubated.

Case Presentation

Our patient was a 46-year-old male of Turkish origin with a significant past medical history of moderate-persistent asthma, multiple exacerbations leading to numerous hospitalizations and one episode of mechanical ventilation. He presented to the hospital with shortness of breath. According to the EMS report, the patient was found on the boardwalk experiencing dyspnea and using accessory muscles. He could only speak in 2-3 word sentences and reported minimal relief from his prescribed albuterol rescue inhaler. Interestingly, the breathless patient asked the ED physician to initiate intubation and use a combination of high-dose steroids and ketamine therapy. This raised our suspicions that he had encountered a similar situation before (Figure 1).

Due to hypoxia and the use of accessory muscles, the patient was initially put on BiPAP. A VBG showed 7.248/59/90/25 on BiPAP settings of 22/10 at FiO_2 50%. The patient was also started on continuous Ipratropium bromide/albuterol nebulization therapy, high-dose steroids, IV magnesium sulfate infusion and a ketamine drip in the ED. However, within an hour, the patient became lethargic and a repeat VBG showed a rapidly decreasing pH to 7.07 despite the patient's tachypnea and BiPAP therapy. The patient was immediately intubated and transferred to the ICU for a higher level of care. A decision was made to continue the IV ketamine drip due to its bronchodilation properties as studied in the past and based on the patient's history of responding positively to ketamine in the past. Unfortunately, ABG revealed that the pH worsened further along with type 2 respiratory failure (6.978/110/537/25 on PRVC ventilator settings of 12/400/100/5).

The patient was breath-stacking and experiencing significant tachypnea without effectively eliminating CO_2. Subsequently, the patient was started on a cisatracurium (Nimbex) drip to paralyze and gain full control of his respiration using the ventilator. Various settings were attempted including adjusting the respiratory rate, increasing expiratory time, and raising PEEP, but the patient remained hypercapnic, with peak and plateau pressures significantly elevated. It became apparent that most options were exhausted as the

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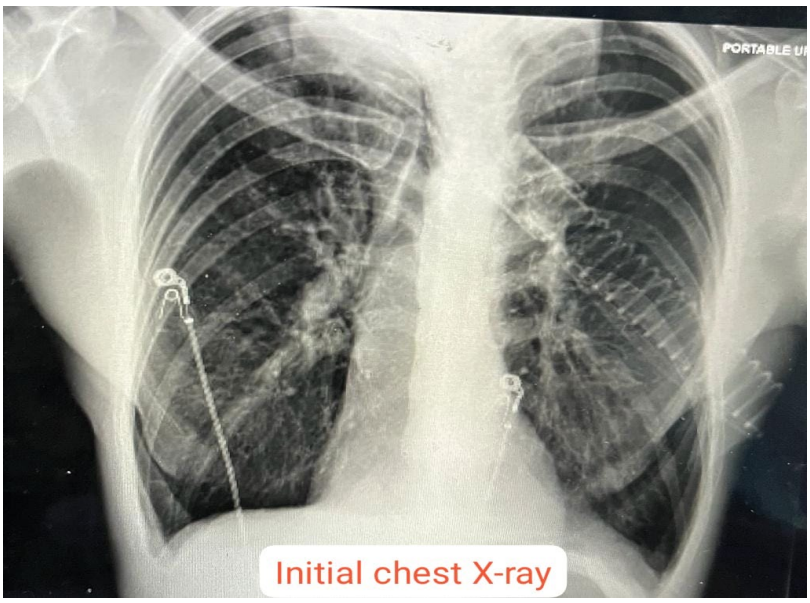

Figure 1: Initial chest X-ray.

patient did not respond to aggressive standard therapy alongside concomitant ketamine and cisatracurium drips.

After a joint discussion involving multiple pulmonologists and intensivists, a decision was made to administer a fixed rate of 4 mcg/min of IV epinephrine. Within a day, the patient's airways showed signs of improvement as evident by the gradual decrease in peak and plateau pressures and ABG indicating a resolution of respiratory acidosis (7.365/58/106/32 on PRVC ventilator settings of 14/450/50/5). Over the next couple of days, the patient was successfully extubated and downgraded from the ICU [1-4].

Discussion

Steroid resistance in Status Asthmaticus, can either be inherited or acquired. In cases of inherited resistance, studies have identified approximately 11 involved genes and it is likely caused by a range of genetic variations that are yet to be fully determined. In acquired resistance, inflammation or oxidative stress can adversely impact glucocorticoid receptor signaling and possible mechanism involves the upregulation of cytokines in the lungs which reduces the affinity of glucocorticoid receptors to steroids and consequently leads to the development of resistance. In our case, the patient most likely experienced acquired resistance due to previously unrecognized inflammation or oxidative stress, as there was no known family history of steroid resistant asthma. Another factor to consider is ketamine resistance; however, further pharmacological research is needed to explore this aspect.

Epinephrine is known for its beta-adrenergic agonist properties and acts as a potent smooth muscle relaxant, helping to alleviate severe bronchospasm as seen in status asthmaticus. In patients with severe airway obstruction, inhaled beta-agonist therapy may theoretically be less effective in delivering medication to the smaller airways when compared to IV administration, as with epinephrine. This ensures more effective drug delivery. However, due to the potential risks of coronary artery vasospasms, arrhythmias and other adverse effects, it is advisable to avoid or delay the use of IV epinephrine until it is absolutely necessary.

Conclusion

In conclusion, while steroid resistance is found in a small number of asthmatic patients, it can be life-threatening. Further research is required at the molecular level to identify these patients early in the disease onset and to implement a different therapeutic approach from the beginning. In our case, we could have proceeded earlier with epinephrine, which might have prevented the need for intubation and a lengthy stay in the ICU.

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