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CASE REPORT

Can High Flow Nasal Cannula Prevent Intubation in Status Asthmaticus?": A Case Report

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ABSTRACT

Overview of the case: A 29-year-old male with status asthmaticus, the GCS score was 14, the respiratory rate was 30 x/min, SpO_2 88% on room air, bilateral lung wheezing, and the blood gas analysis revealed severe respiratory acidosis. Management: Treatment involved High Flow Nasal Cannula (HFNC) oxygenation, salbutamol and ipratropium bromide nebulization, aminophylline drip infusion, and intravenous corticosteroids. Within hours, there was a significant improvement in respiratory parameters and acidosis. Subsequent monitoring in the intensive care unit showed improvement, the patient successfully being weaned off HFNC and transferred to the general ward after six days. This case highlights the efficacy of HFNC in managing severe asthma exacerbation and preventing intubation. Results: The use of HFNC, when combined with standard asthma management, has proven to be a promising option in the non-invasive management of status asthmaticus and can prevent intubation, but should be monitored carefully due to the risk of delayed escalation to respiratory support.

Keywords: High flow nasal cannula, intubation prevention, intensive care, respiratory distress, status asthmaticus

INTRODUCTION

High Flow Nasal Cannula (HFNC) is a modality of non-invasive oxygenation that can be used for acute respiratrory distress. We can use HFNC as a choice of treatment for a patient who has 'borderline' indications, such as early sign of respiratory distress, with quite good consciousness, and does not meet enough criteria to be intubated. One good example is status asthmaticus, which is expected to be controlled in a short time. This case report discusses the role of HFNC in preventing the need for intubation in status asthmaticus.

CASE

A 29-year-old male presented to the emergency room with severe dyspnea. He had a history of uncontrolled asthma since childhood. Physical examination revealed a Glasgow Coma Scale score of 14, respiratory rate of 30 breaths per minute, peripheral oxygen saturation of 88% on room air, tachycardia at 112 beats per minute, normal blood pressure, and expiratory wheezing in both lungs. Early blood gas analysis showed severe respiratory acidosis (pH 7.00, pCO_2 124 mmHg, pO_2 249 mmHg).

Treatment in the emergency room involved HFNC (High Flow Nasal Cannula) oxygenation, salbutamol + ipratropium bromide nebulization, intravenous drip of aminophylline, and intravenous dexamethasone. The patient's peripheral saturation reached 99% with a flow rate of 50 liters per minute and FiO_2 of 80%. Respiratory rates and wheezing improved after several hours, and subsequent blood gas analysis showed an improvement in acidosis (pH 7.32 | pCO_2 61 mmHg | pO_2 240 mmHg).

The next blood gas analysis on day 6 showed improvement (pH 7.48 | pCO_2 33 mmHg | pO_2 157 mmHg). The patient remained stable during monitoring in the intensive care unit for six days, the ROX index improves, and HFNC could be weaned. Subsequently, the patient was safely moved to the general ward.

DISCUSSION

High flow nasal cannula (HFNC) is a therapeutic technique that delivers heated and humidified gas at a rate greater than the patient's inspiratory flow. The HFNC device operates by delivering high fractions of oxygen, offering various advantages, including nasopharyngeal dead space clearance, increased expiratory volume and functional residual capacity, provision of appropriately humidified air to the respiratory tract, and reduced inspiratory resistance. The mechanisms through which HFNC enhances ventilation efficiency encompass:1

- Reducing respiratory effort by minimizing inspiratory airway resistance and nasopharyngeal resistance.
- Decreasing energy expenditure as HFNC adequately humidifies, thus diminishing water loss on the respiratory mucosa and metabolic work.
- Enhancing lung compliance and mucociliary function by providing warm and moist air.
- Clearing the nasopharyngeal dead space to augment alveolar ventilation.
- Generating distending pressure, as HFNC generates positive pressure.

This method has several beneficial mechanisms for patients with status asthmaticus. First, it reduces anatomical dead space by flushing the nasopharyngeal cavity, potentially improving CO_2 clearance. Additionally, HFNC provides a certain level of positive end-expiratory pressure (PEEP), which can range from 2 to 7 cm H_2O depending on the flow rate used, to gain the maximum benefit of PEEP from high-flow nasal cannula therapy. The approximate magnitude of PEEP generated with a closed mouth is about 1 cm of water pressure for 10 liters flow. This external PEEP may reduce airway resistance and work of breathing. HFNC may help reduce the metabolic cost of breathing by supplying adequately warmed and humidified gas. It can effectively reduce dynamic hyperinflation in patients with obstructive lung disease, thus breaking the vicious circle associated with asthma exacerbation.[2,3]

A method for evaluating high flow nasal canula is ROX index. The ROX index is the ratio of SpO_2/FIO_2 to respiratory rate is used to predict outcome of Nasal High Flow Cannula therapy (HFNC). ROX score greater than or equal to

4.88 measured at 12 hours predicts lower risk of progressing to mechanical ventilation. The cut-off score to predict the failure of HFNC are ROX < 2.85 at 2 hours, < 3.47 at 6 hours, < 3.85 at 12 hours.[4]

The study reviews the use of HFNC for status asthmaticus, mostly applied to pediatric patients. The study by Baudin et al. (2017) stated that Nasal High Flow (NHF) therapy has been shown to be effective in managing children with status asthmaticus, as evidenced by a retrospective observational study conducted in a pediatric intensive care unit (PICU). It found that NHF therapy improved physiological parameters within the first 24 hours of treatment and significantly improved clinical parameters and blood gas levels. Only a small percentage of patients required alternative respiratory support, suggesting that NHF may be a feasible and safe option for managing severe asthma exacerbations and potentially preventing the need for intubation.[5]

The study by Pilar et al. (2017) reviews the comparison between HFNC and Non-invasive positive pressure ventilation (NIPPV) in asthma exacerbation management. They performed a retrospective analysis enrolling 42 children with severe acute asthma exacerbations admitted to the PICU. Twenty children received HFNC, and eight of them required NIPPV as escalated respiratory support. Twenty-two children received NIPPV without treatment failure and demonstrated significant differences compared with the HFNC group ($p < 0.001$); none of these children required intubation. They suggested that HFNC should be used cautiously as the initial noninvasive respiratory support in cases of severe acute asthma exacerbation because of the risk of delay in escalating the respiratory support.[6]

From this case, the patient's response to HFNC therapy was remarkable, with his peripheral oxygen saturation reaching a satisfactory level, and respiratory parameters significantly improving over time as shown on picture 1 above. The case report demonstrated that HFNC, when combined with standard asthma management, proved to be a promising option in the management of severe asthma exacerbations. The ability to adjust the flow rate and FiO2 of HFNC allowed for precise oxygen titration, preventing hypoxemia while avoiding the complications associated with higher oxygen concentrations.

The patient's stable condition and successful weaning from HFNC after six days of intensive care monitoring, highlight the potential of this therapy in facilitating a smoother transition from critical care to the general ward. This case report suggests that HFNC can be a valuable addition to the good option for managing severe asthma exacerbations and may play a significant role in preventing the need for more invasive respiratory support.

CONCLUSION

The use of HFNC, when combined with standard asthma management, has proved to be a promising option and can prevent intubation in the management of severe asthma exacerbations. However, it should be used cautiously as the initial noninvasive respiratory support in cases of severe acute asthma exacerbation due to the risk of delaying the escalation of respiratory support.

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