Case Report

Weaning in Asthmatics: A Finely Supervised Action

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Abstract

Respiratory failure from severe asthma is a potentially reversible, life-threatening condition. Since asthma involves bronchospasm and mucous plugging, it causes increased pressure difference between peak and plateau pressure. The increased pressure difference between the two can be due to ventilatory strategy of asthma itself which involves increased inspiratory flow rate and square flow pattern to increase expiratory time. It is important that clinicians managing such patients understand the use of mechanical ventilation since wrong interpretation may lead to inappropriate decision making during weaning.

Keywords: Asthma ventilator strategy, bronchospasm, severe asthma, ventilatory weaning

Introduction

Asthma continues to inflict significant morbidity and mortality worldwide. It is estimated that about 10% of individuals admitted to hospital for asthma go to the Intensive Care Unit, with 2% of all admitted patients being intubated when conventional medical therapy fails.[1] The physician has to pay close attention to basic principles of ventilating patients with severe asthma: low tidal volume and respiratory rate, prolonged expiratory time, shortened inspiratory time, and monitoring for the development of dynamic hyperinflation.

Case Report

A 13-year-old girl with childhood asthma and noncompliance with therapy was admitted to the hospital with shortness of breath. She was transferred to Intensive Care Unit in view of worsening hypoxia and respiratory distress. She was tachycardic with heart rate of 132/min, respiratory rate of 40/min, and oxygen saturation of 84% while breathing oxygen through nonrebreathing mask at 15 L/min, despite multiple bronchodilator nebulisations and intravenous hydrocortisone. Her chest X-ray was suggestive of right middle lobe collapse which was confirmed by computed tomography scan. All other routine investigations were normal.

On worsening of oxygenation and apparent respiratory distress, she was intubated with 7.5 mm ID endotracheal tube. She was given remifentanil, propofol, and succinylcholine for intubation. Assist Control Ventilation (ACV) was initiated with respiratory rate of 12/min, tidal volume of 350 ml, and positive end-expiratory pressure (PEEP) of zero. To further increase the expiratory time, flow was kept at 80 L/min and square flow pattern initiated to keep I:E ratio around 1:3.

She was started on remifentanil and propofol infusion with the instruction of cisatracurium 7 mg intravenous if ventilator asynchrony occurs. Fiberoptic bronchoscopy was done to open the collapsed lung. Due to increased requirement of paralysis, an infusion of cisatracurium was started. Other medical management included clarithromycin 500 mg intravenously twice daily, salbutamol nebulization, intravenous hydrocortisone, and enoxaparin subcutaneously for deep venous thrombosis prophylaxis.

After the initiation of mechanical ventilation, her peak airway pressure was around 82 cm H_2O while plateau pressure was 27 cm H_2O, suggesting markedly increased airway resistance. After about 36 h of mechanical ventilation, her peak and plateau pressure dropped to 61 cm H_2O and 20 cm H_2O, respectively. Although peak and plateau pressures had reduced, the high-pressure difference between the two airway pressure variables was suggesting partial improvement of the underlying disease process. All other parameters had

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improved including oxygenation with a PaO_2/FiO_2 ratio of more than 300, hemodynamic stability, improvement in lung collapse, normal mental status on stopping propofol and remifentanil and no new problem. Weaning and extubation were decided upon based on clinical grounds. The patient was stable post extubation and shifted out of ICU after 24h of observation.

Discussion

When an asthmatic patient is ventilated, severe hyperinflation (auto-PEEP) can result from breath stacking. This occurs because there is incomplete emptying of alveolar gas due to reduced expiratory flow consequent to increased airway resistance.[2] It is essential to prevent severe hyperinflation to avoid complications such as hypotension and barotrauma.[3] Ventilatory strategies that can be adopted to reduce hyperinflation in the intubated and ventilated asthmatic patients include low respiratory rate, low tidal volume, shorter inspiratory time, and higher inspiratory flow so that exhalation time is increased.[4-6] The reduction in respiratory rate is most useful. Inspiratory flow with decelerating waveform configuration is reasonable initially. If the reduction in respiratory rate is insufficient to reduce hyperinflation; then, the inspiratory time can be reduced and an increase in inspiratory flow rate would ensure sufficient delivery of tidal volume. Reduction of tidal volume is appropriate, if required but with it, dead space fraction will increase. Occasionally, inspiratory pressure limit may need to be raised to 100 cm H_2O so that the patient receives the full tidal volume. The use of square wave flow pattern and increasing flow rate may also be useful to reduce inspiratory time and hyperinflation. This does not significantly increase danger of barotrauma.[3,7]

In our patient, use of increased inspiratory flow rate and square wave flow pattern led to very significant pressure difference between peak and plateau pressure. Although this pressure difference decreased with aggressive nebulization and suctioning, it was still very high at the time when decision of weaning was made.

The persistently increased peak airway pressure suggested that it was due to bronchospasm and mucus plugging but was in part contributed by ventilatory setting, notably increased inspiratory flow rate and square wave flow pattern. It was inappropriately interpreted that underlying disease is not resolved and patient is not fit for weaning. When the decision to wean was made based on clinical impression, she could be successfully weaned and extubated following which she was completely stable.

Conclusion

Ventilation of asthmatics is difficult. Asthmatics should be weaned from ventilator as early as possible. Monitoring of reversal of underlying disease process by following ventilatory variables alone can be misleading. Clinical judgement along with a thorough understanding of ventilatory management of asthma is needed to avoid inappropriate decision making and treatment.

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Conflicts of interest

There are no conflicts of interest.

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