

Pediatric Ventilator Management in the Emergency Department



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KEYWORDS

- Mechanical ventilation • Airway • Pediatric • Blood gas analysis • Ventilator alarm
- Hemodynamic instability

KEY POINTS

- Pediatric mechanical ventilation often brings the emergency physician trepidation and hesitation.
- Common modes of pediatric invasive ventilation include pressure-assist control ventilation and pressure-regulated volume control ventilation.
- A methodic approach is needed when the emergency physician addresses ventilator alarms and the decompensating pediatric patient that is mechanically ventilated.

INTRODUCTION

There are few emergencies that are as anxiety provoking to the emergency physician (EP) as pediatric airway management. Pediatric intubation itself is relatively rare compared with adult intubations. The frequency of pediatric endotracheal intubation (ETI) is reported to occur 3 to 6 times less often per 1000 adult patients intubated.^{1,2} Furthermore, once intubated, the EP usually has even less experience with pediatric ventilator management in the emergency department (ED). This article uses clinical cases to provide a reference for reviewing initiation of pediatric mechanical ventilation

Funding Sources/Disclosures: None.

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Emerg Med Clin N Am 36 (2018) 401–413

<https://doi.org/10.1016/j.emc.2017.12.008>

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in the ED and adjusting the initial settings in response to blood gas analysis. The review also provides a reference for appropriately evaluating ventilator alarm triggers and accurately evaluating and managing the unstable ventilated pediatric patient. Common modes for emergency pediatric ventilation are discussed. These include pressure-assist control ventilation (PCV) and pressure-regulated volume control ventilation (PRVC).

CASES IN PEDIATRIC MECHANICAL VENTILATION MANAGEMENT

Case 1

A 7-year-old girl presented to the ED with massive hemoptysis and profound hypoxemia. The patient had signs of hemorrhagic shock and became apneic during the evaluation of her primary survey, subsequently requiring ETI and mechanical ventilation. A chest x-ray (CXR) study confirmed tube placement and showed significant bilateral opacification. She was placed on synchronized intermittent mandatory ventilation (SIMV) PCV. Her peak inspiratory pressure (PIP) was 18 cmH₂O above positive end-expiratory pressure (PEEP) of 10 cm H₂O, her respiratory rate (RR) was 24, and fraction of inspired oxygen (FiO₂) was 1.0. The patient remained hypoxic despite increases in PEEP and 100% FiO₂. What ventilator adjustments are necessary for this patient with refractory hypoxemia?

Case 2

A 4-year-old girl presented to the trauma center with traumatic brain injury (TBI). The patient was intubated for airway protection and for her anticipated clinical course. A venous blood gas level was obtained after intubation. The results were pH of 7.19 and partial pressure of carbon dioxide (P_{CO₂}) of 52 mm Hg. Her weight was estimated to be 16 kg. The ventilator was set to the following parameters before intubation: SIMV PRVC; RR, 24; tidal volume (V_t), 96 mL; PEEP, 5; FiO₂, 1.0; and inspiratory time (T_i), 0.8 seconds. What ventilator setting adjustments should be made for this 4-year-old girl with TBI?

Case 3

A 3-year-old boy with a history of asthma presented with significant respiratory distress. He had a respiratory rate of 75 to 80 breaths per minute. Initial observation found that he was febrile and had subcostal, supraclavicular, intercostal retractions and tracheal tugging. On auscultation, there was biphasic wheezing in the upper lobes but very little aeration at the bases. He appeared somnolent and had very little crying with intravenous line placement. His peripheral capillary oxygen saturation (SpO₂) level was in the 80s despite being on 15-mg/h continuous albuterol facemask with a flow of 15 L/min and below that a humidified high-flow nasal cannula (HFNC) set at 8 L/min. The radiograph was concerning for multifocal pneumonia. He required intubation for acute respiratory failure and airway protection. He was placed on SIMV PRVC ventilation and started on a ketamine and epinephrine infusion for his airway obstruction component. His continuous albuterol was increased to 20-mg/h. He was pan cultured and started on empiric antibiotics. The ventilator triggered an alarm with peak airway pressures (PAP) of 49 cm H₂O. The oxygen saturation continued to decline. What is the next step to improve his respiratory status?

Case 4

A 6-month-old girl presented to the ED with 3 days of worsening respiratory distress. Her pediatrician recently diagnosed her with bronchiolitis. Despite nasal suctioning, she had little improvement in her work of breathing, and she had worsening hypoxia.

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