Abstract:
Rapid-sequence intubation is the standard for definitive airway management in the emergency department and requires multiple stepwise tasks where the sequence and timing are important. Optimal performance of this critical procedure can be challenging, and common pitfalls exist that emergency providers may encounter when performing rapid-sequence intubation in children. Prolonged and/or failed endotracheal intubation attempts and adverse effects are not infrequent, especially in neonates and young children. Formal standardization of the approach and use of technological advances in intubation and monitoring equipment can decrease variation in the process, improve team-level situational awareness, and mitigate risk to the patient. This article reviews the required planning and preparatory steps, and offers specific strategies aimed at mitigating the associated risks and potential pitfalls to enhance the likelihood of success and safety during the performance of this high-risk procedure in children.

Keywords:
rapid-sequence intubation; desaturation; preoxygenation; laryngoscopy; airway management; pediatrics

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A Modern and Practical Review of Rapid-Sequence Intubation in Pediatric Emergencies

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Rapid-sequence intubation (RSI) is the standard for definitive airway management in the emergency department (ED).[1–3] *Rapid-sequence intubation* is defined as the combination of preoxygenation with the administration of sedative and neuromuscular blocking medications (NMBs) in rapid succession to optimize conditions for efficient endotracheal tube placement in critically ill or injured patients while limiting the risk of patient harm.[4] Although laryngoscopy and insertion of the endotracheal tube are central to RSI, these portions of the procedure may be overrepresented in the peer-review literature and trainee education programs. In practice, RSI requires multiple stepwise tasks where the sequence and timing of steps are vital. Optimal performance of RSI can be challenging because of the severity of a patient's illness, tremendous cognitive load associated with caring for a critically ill or injured patient, and the multiple co-occurring events of an active resuscitation.

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Figure 1 depicts the general approach to RSI in our pediatric ED. This approach has been developed based on standard descriptions of RSI, greater than 7 years' experience of performing and studying RSI, and formal ongoing quality improvement work to optimize the safe performance of RSI in our ED. Through these research and improvement efforts with data collected by video review, we have participated in or reviewed videos of nearly 500 cases of RSI. The current review is based on the approach described in Figure 1 and assumes some basic knowledge of RSI. We will focus on optimizing performance of the entire RSI process, not just laryngoscopy and endotracheal tube insertion, as well as the common pitfalls that emergency care providers may encounter when performing RSI in children. Rapid-sequence intubation is appropriate for the vast majority of pediatric patients; and many of the difficult cases are due to a combination of inadequate preparation, the anxiety that accompanies any ED intubation, and deviation from the standard approach when "unexpected" issues arise after laryngoscopy begins. References are provided for statements where we are aware of available evidence in the peer-review literature. In the absence of evidence in the peer-review literature, we attempt to provide guidance based on experience.

BRIEF HISTORY OF RSI

Rapid-sequence intubation is derived from approaches developed by anesthesiologists to make emergency airway management as safe as possible for unfasted patients by attempting to limit the risk of vomiting and aspiration. We are not aware of randomized trials of RSI in a prehospital or ED setting, but decades of experience and numerous observational studies have demonstrated greater endotracheal intubation success with the addition of an NMB compared with a sedative alone.[2,1,5,6] For neonatal intensive care unit patients, randomized trials of RSI have demonstrated higher first-attempt success and improved safety when RSI is used.[7,8]

SAFETY OF RSI

Although RSI is the preferred approach for the vast majority of pediatric patients, prolonged and/or failed endotracheal intubation attempts and adverse effects are common, especially in neonates and young children.[8–12] One potential explanation for these findings may be that RSI is performed infrequently by individual providers for pediatric patients, including in the ED setting. In a study of RSI in a pediatric ED with more than 90 000 annual visits, endotracheal intubation was performed 147 times in a single year, with 123 of these instances representing RSI.[9] Nearly two thirds of pediatric emergency medicine faculty and fellow physicians in this pediatric ED did not perform a single endotracheal intubation during the 12-month study period.[13] Although data were not collected to evaluate the exposure of individual respiratory therapists, nurses, paramedics, and resident physicians, it is likely that few, if any, providers from these groups participated in enough cases of RSI to ensure optimal procedural performance based on clinical experience alone. When the relative infrequency of pediatric RSI is coupled with its complexity, significant risk emerges with substantial variation in the process and threat to patient safety.

DECISION TO PERFORM RSI

The decision to establish a definitive airway is based on many factors. In pediatric ED patients, some of the considerations include the ability to oxygenate and ventilate (eg, apnea or hypoventilation), presence or absence of airway protective reflexes, and anticipated clinical course (eg, septic shock, severe head injury in need of diagnostic neuroimaging, altered mental status). As important as knowing the indication to perform RSI is the identification of clues that RSI may prove more challenging than anticipated. Before committing to the RSI procedure, the emergency provider should assess for: (1) anticipated difficulties with performing bag mask ventilation (BMV), (2) indicators of a potentially difficult airway, and (3) an understanding of the patient's present physiology to the extent possible.

Difficult Bag Mask Ventilation

Questions to consider include the following: (1) Does the patient's facial anatomy allow for an effective mask seal? (2) Can the jaw be easily manipulated? (3) Is the airway patent when maintained by external manual manipulation? (4) Can a few breaths be given easily with BMV?