

Incidence and Duration of Continuously Measured Oxygen Desaturation During Emergency Department Intubation

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Study objective: Desaturation during intubation has been associated with serious complications, including dysrhythmias, hemodynamic decompensation, hypoxic brain injury, and cardiac arrest. We seek to determine the incidence and duration of oxygen desaturation during emergency department (ED) rapid sequence intubation.

Methods: This study included adult rapid sequence intubation cases conducted between September 2011 and July 2012 in an urban, academic, Level I trauma center ED. We obtained continuous vital signs with BedMasterEX data acquisition software. Start and completion times of rapid sequence intubation originated from nursing records. We defined oxygen desaturation as (1) cases exhibiting SpO₂ reduction to less than 90% if the starting SpO₂ was greater than or equal to 90%, or (2) a further reduction in SpO₂ in cases in which starting SpO₂ was less than 90%. We used multivariable logistic regression to predict oxygen desaturation during rapid sequence intubation.

Results: During the study period, there were 265 rapid sequence intubation cases. The study excluded 99 cases for failure of electronic data acquisition, inadequate documentation, or poor SpO₂ waveform during rapid sequence intubation, and excluded cases managed by anesthesia providers, leaving 166 patients in the analysis. After preoxygenation, starting SpO₂ was greater than 93% in 124 of 166 cases (75%) and SpO₂ was less than 93% in the remaining 46 cases. Oxygen desaturation occurred in 59 patients (35.5%). The median duration of desaturation was 80 seconds (interquartile range 40, 155). Multivariable analysis demonstrated that oxygen desaturation was associated with preintubation SpO₂ less than 93% (odds ratio [OR] 5.1; 95% confidence interval [CI] 2.3 to 11.0), multiple intubation attempts (>1 attempt) (OR 3.4; 95% CI 1.4 to 6.1), and rapid sequence intubation duration greater than 3 minutes (OR 2.7; 95% CI 1.2 to 6.1).

Conclusion: In this series, 1 in 3 patients undergoing ED rapid sequence intubation experienced oxygen desaturation for a median duration of 80 seconds. Preintubation saturation less than 93%, multiple intubation attempts, and prolonged intubation time are independently associated with oxygen desaturation. Clinicians should use strategies to prevent oxygen desaturation during ED rapid sequence intubation. [Ann Emerg Med. 2016;67:389-395.]

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INTRODUCTION

Background

Rapid sequence intubation is a central technique in emergency department (ED) airway management. An important related adverse event is oxygen desaturation and resultant hypoxemia, which has been associated with dysrhythmias, hemodynamic decompensation, hypoxic brain injury, and cardiac arrest, particularly at saturations below 70%.¹⁻⁶ Clinical guidelines emphasize the importance of avoiding oxygen desaturation and hypoxemia. Both the EAST Guidelines 2012 and Brain Foundation Guidelines enforce the importance of avoiding hypoxia (SpO₂ <90%) in brain injury, pointing to an increase in morbidity and mortality.^{7,8}

Importance

Despite the perceived importance of this adverse event, little is known about the true rates of desaturation during ED rapid sequence intubation. Previous studies of advanced airway management strategies, not all restricted to emergency rapid sequence intubation or emergency physicians, have reported desaturation occurring in 0.2% to 19.2% of cases.⁹⁻¹⁶ Some of these studies reporting low desaturation rates used definitions that may have underestimated desaturation events. For example, one multicenter study reporting a less than 1% rate of desaturation excluded patients experiencing esophageal intubation.¹⁵ Another study from an

Editor's Capsule Summary*What is already known on this topic*

Oxygenation desaturation during rapid sequence intubation is potentially harmful.

What question this study addressed

What are the incidence and characteristics of oxygen desaturation during emergency department (ED) rapid sequence intubation?

What this study adds to our knowledge

In this series using a continuous vital sign data acquisition system, oxygen desaturation (SpO₂ decrease <90%) occurred in 59 of 166 ED rapid sequence intubation cases (35.5%), with a median duration of 80 seconds.

How this is relevant to clinical practice

Clinicians should consider strategies to prevent oxygen desaturation during ED rapid sequence intubation.

academic trauma center reporting hypoxemia in only 1.2% of rapid sequence intubation cases excluded hypoxemic events attributed to underlying injury.¹⁶ Studies reporting much higher rates of desaturation, 18.2% and 19.2%, included all instances of hypoxemia regardless of underlying cause.^{13,14}

Previous studies of rapid sequence intubation desaturation have relied on self-reported data and thus may have missed important episodes of desaturation.⁹⁻¹⁶ Continuously recorded oxygen saturation data can overcome this important limitation. An out-of-hospital study that used continuously recording pulse oximeters found a much higher rate of desaturation than in previous studies using self-reported values.¹⁷

A better understanding of the true rates of and the factors associated with oxygen desaturation during ED rapid sequence intubation could influence practice, identifying opportunities to improve rapid sequence intubation technique or the application of strategies to prevent desaturation events.

Goals of This Investigation

The goal of this study was to determine the incidence and duration of oxygen desaturation during ED rapid sequence intubation. In addition, we sought to identify factors associated with rapid sequence intubation oxygen desaturation.

MATERIALS AND METHODS**Study Design and Setting**

This was an institutional review board–approved, cross-sectional survey of existing airway management practice conducted between September 2011 and July 2012 in the University of New Mexico Hospital Emergency Department, which is an urban Level I trauma center with an Accreditation Council for Graduate Medical Education–approved emergency medicine residency and a total annual volume of approximately 90,000 patients.

Standard airway practice in our ED uses rapid sequence intubation coupled with direct or video laryngoscopy performed in resuscitation or trauma rooms. Preoxygenation is typically performed with a nonrebreather mask set at 15 L/min or greater for several minutes or bag-valve-mask ventilations with supplemental oxygen at 15 L/min or greater when the patient remains hypoxemic despite a nonrebreather mask. During the study period, the use of apneic (passive) nasal oxygenation during the rapid sequence intubation attempt was not common in our ED.^{1,18} Available airway devices included direct laryngoscopy with straight or curved blades and the Storz CMAC video laryngoscope (Karl Storz, El Segundo, CA) with both C and D blades. Attending emergency medicine faculty were present for all rapid sequence intubation attempts and occasionally performed intubations independently when residents were not present or after failed intubation attempts by residents.

Selection of Participants

Using electronic records from the ED automated medication management system (Pyxis MedStation; CareFusion Corp, San Diego, CA), we identified all patients for whom a paralytic medication was dispensed during the study period. We reviewed ED clinical charts and airway quality assurance data collection forms to verify that the paralytic agent was used for rapid sequence intubation. We included all adult (>18 years) medical and trauma patients undergoing rapid sequence intubation by emergency medicine residents or faculty.

We excluded cases in which there was failure of electronic vital sign data acquisition, inadequate nursing or physician documentation of the procedure, or a poor SpO₂ waveform during rapid sequence intubation, as well as those in which anesthesia providers managed the case.

Methods of Measurement

We determined rapid sequence intubation vital signs through a bedside continuous data acquisition system (BMEX data acquisition system; Excel Medical Electronics, Jupiter, FL). This software prospectively records all vital

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