

Difficult Intubation Factors in Prehospital Rapid Sequence Intubation by an Australian Helicopter Emergency Medical Service



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Abstract

Objective: Prehospital rapid sequence intubation (RSI) of critically ill trauma patients is a high-risk procedure that may be associated with an increased rate of severe complications such as failed intubation, failure of oxygenation, hypoxia, hypotension, or need for surgical airway. The objective of this study was to describe the factors associated with difficult intubation in prehospital RSI as defined by more than a single look at laryngoscopy to achieve tracheal intubation.

Methods: This is an observational study using prospectively collected data.

Results: Four hundred forty-three RSIs were performed. Paramedics were the initial laryngoscopist in 290 (65.5%). First-look laryngoscopy resulted in successful tracheal intubation (TI) in 372 (84.0%) (95% confidence interval, 80.3%-87.1%). Intubation was achieved on second look at laryngoscopy in 58 (13.1%). "First-pass" TI was achieved in 394 (88.9%). Overall, successful TI was achieved in 438 (98.9%) (95% confidence interval, 97.4%-99.5%). Complications occurred in 116 (26.2%), with desaturation the commonest in 77 (17.4%).

Conclusion: Factors associated with more than 1 look at laryngoscopy before TI included paramedic laryngoscopist and the presence of at least 1 of the following indicators: blood/vomitus in the airway, limited mouth opening, and limited neck movement. Trauma to face/neck, obese body habitus, C-spine precautions, cricoid pressure, midline stabilization, and intubation on the ground did not influence the level of difficulty encountered.

Introduction

Air medical retrieval teams in Australia routinely undertake prehospital rapid sequence intubation (RSI) for patients with severe traumatic injuries. The majority of services within Australia use a critical care physician/retrieval paramedic team for air medical prehospital scene responses, and this is the model under which Greater Sydney Area Helicopter Emergency Medical Service (GSA-HEMS), New South Wales, Australia, operates.

Prehospital RSI of critically ill trauma patients is potentially a high-risk procedure that has been shown to have an increased rate of severe complications such as failed intubation, failure of oxygenation, transient hypoxia, hypotension, or need for surgical airway compared with other settings such as the operating room environment.^{1,2}

The reasons for this are multifactorial; the patients often have significant physiological and/or anatomic derangement, and they usually require cervical spinal precautions, which limit ideal positioning to facilitate intubation. They may have significant comorbidities, and they are very likely to be nonfasted.²

The aim of this study was to describe the factors associated with difficult intubation, as defined by requiring more than a single look at laryngoscopy to achieve successful tracheal intubation (TI), in prehospital RSI by physician/paramedic teams within a dedicated air medical retrieval service operating in New South Wales, Australia.

Methods

This observational study was conducted using prospectively collected data for the period September 2009 to September 2013 at GSA-HEMS, Aeromedical Division of New South Wales Ambulance Service. The service is a dedicated air medical prehospital and interhospital retrieval service with 3 bases of operation in Sydney, Wollongong, and Orange that responds to approximately 3,000 missions per year; approximately 1,100 each year involve prehospital trauma scene responses. The service uses a critical care physician/retrieval paramedic team for all missions including remote access winch operations.

Recognizing the inherent risks of prehospital RSI, GSA-HEMS integrates a range of safety systems into prehospital RSI including a service-wide standard operating procedure (SOP), a preintubation challenge-response checklist, monthly RSI clinical training "currencies," regular simulation training, apneic diffusion oxygenation, tracheal bougie for all intubations, and a

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1067-991X/\$36.00

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<http://dx.doi.org/10.1016/j.amj.2015.10.002>

standardized approach for inability to intubate the trachea. All RSI cases are followed up with regular airway audits, and a detailed airway registry is maintained for all intubations.

The service's SOP allowed discretion by the HEMS physician as to who should perform the first laryngoscopy. However, from September 2011, the SOP was amended to mandate that the HEMS physician should perform first laryngoscopy if the airway assessment was deemed likely to be difficult or if full preoxygenation could not be achieved (defined as arterial oxygen saturation [SaO₂] > 98%). This increased the number of first laryngoscopies performed by the HEMS physician after that time.

The study sample size was based on inclusion of all patients undergoing prehospital RSI by the service. The physician completed the online Airway Registry immediately after each mission. The accuracy of the Airway Registry is maintained prospectively by daily checks against mission case sheet documentation and any missing data corrected at that time.

Definitions

Research on prehospital airway management has been impeded by a lack of standardized definitions and outcome measures with variable usage of terms like "first attempt" and "first pass" and "ease of intubation," each having a range of definitions.^{3,4} In some articles, "attempt" refers to "attempt at tracheal tube passage"^{3,4} and in others "attempt at laryngoscopy," which makes a comparison between services or systems impossible based on these measures.

The most recent attempt to bring these issues to resolution has been the development of an Utstein-style set of airway core variables by Sollid et al⁵ and Lossius et al.⁶ Unfortunately, this article defined the term "attempts at airway intervention" as the "number of attempts at securing the airway with a supraglottic airway device or TI," which will do nothing to improve the ambiguity inherent in the term "attempt" and in fact implies that attempted supraglottic airway device or tube passage is the preferred definition instead of attempt at laryngoscopy, which is a more sensitive and useful definition.

There is also wide variation in the published literature regarding the definition of "difficult intubation," with some authors suggesting that more than 2 (or even 3) "attempts" should be the cutoff for a "difficult" airway but with varying definitions of the term "attempt."^{3,5} Other studies have used view on laryngoscopy as a measure of a difficult intubation.³ Previous studies have identified that more than 2 attempts at laryngoscopy correlate with an increased risk of complications such as hypoxia, hypotension, aspiration, and cardiac arrest.⁷

The authors of this study used the following definitions. A single look at laryngoscopy was defined as a single passage of the laryngoscope blade past the lips by 1 operator. A first-pass intubation was defined as a single passage of a tracheal tube past the lips leading to successful tracheal intubation. Difficult intubation was defined as one that required more

than a single look at laryngoscopy to achieve successful TI. The authors believe that a requirement for more than a single look at laryngoscopy is a more sensitive and appropriate definition and avoids ambiguity with the term "attempt." A failed airway was defined as one in which the initial method chosen for airway management, usually oral TI, was not successful and an alternative method needed to be undertaken. Airway rescue maneuvers were defined as bag valve mask ventilation after induction for RSI, insertion of oro/nasopharyngeal airway after induction, or laryngeal mask airway insertion. Complications were defined as peripheral oxygen saturation < 93% at any time (even if the patient was hypoxic before intubation), bradycardia (< 60/min), hypotension requiring intravenous fluid or blood transfusion, visible airway trauma, esophageal or mainstem bronchial intubation, vomitus appearing in the airway after induction, laryngospasm, cardiac arrest after induction, or the performance of a surgical airway.

All intubations were conducted using direct laryngoscopy. All tracheal tube placements were confirmed with waveform capnography using the Lifepack 15 (Physio-Control, Redmond, WA) monitor or a backup device (EMMA Capnometer; Masimo, Irvine, CA) according to the service's SOP.

Statistical Analysis

Hosmer and Lemeshow's purposeful selection of variables approach⁸ was used to identify on-scene risk factors for difficult prehospital intubations. Variables significant on univariate testing (based on the Wald test and *P* value cutoff point of .25) were selected as candidates for multivariate analysis. During the iterative process, covariates were removed from the model if they were nonsignificant (evaluated at the 0.1 alpha level) and not a confounder (induced change in any remaining parameter estimate of no more than 15% compared with the full model). Variables not selected for the original multivariate model were then reconsidered one at a time. Any that were significant at the 0.15 level were placed in the model, which was again iteratively reduced with respect to the additional variables only. Ethics approval for this analysis was obtained from the South Western Sydney (RPAH Zone) Human Research Ethics Committee.

Results

Four hundred forty-three prehospital RSIs occurred in 50 months. Air medical retrieval paramedics were the initial laryngoscopist in 290 (65.5%). The majority of patients were males, and more than 90% were traumatically injured (Table 1). The majority of patients were transported by rotary wing aircraft. Teams performing road and rotary wing transports were identical in skill mix and equipment.

First-look laryngoscopy resulted in successful TI in 372 (84.0%) (95% confidence interval, 80.3%-87.1%). Intubation was achieved on second look at laryngoscopy in 58 (13.1%). "First-pass" TI was achieved in 394 (88.9%). Overall, successful TI was achieved in 438 (98.9%) (95% confidence interval,

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