Association Between Difficult Airway Predictors and Failed Prehosptial Endotracheal Intubation

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Abstract

Objective: Difficult airway predictors (DAPs) are associated with failure of endotracheal intubation (ETI) in the emergency department (ED). The purpose of this study was to determine if DAPs are associated with failure of prehospital ETI.

Methods: This retrospective study compared the prevalence of DAPs in cases of failed prehospital ETI successfully intubated in the ED (FPH/SED) with cases with no prehospital attempt that were successfully intubated in the ED on the first attempt by a physician using direct laryngoscopy (NPH/SED). All cases were transported by ground or air to an academic, level-1 trauma center.

Results: A total of 1377 ED ETIs were performed; 161 FPH/SED and 530 NPH/SED were identified. The odds ratios with 95% confidence intervals (CIs) of finding DAPs in the FPH/SED group compared with the NPH/SED group was blood = 5.80 (95% CI, 3.89-8.63), vomit = 2.01 (95% CI, 1.25-3.21), short neck = 2.67 (95% CI, 1.39-5.03), neck immobility = 2.52 (95% CI, 1.72-3.67), airway edema = 10.52 (95% CI, 4.15-29.92), facial trauma = 4.64 (95% CI, 2.91-7.39), and large tongue = 3.08 (95% CI, 1.75-5.40). When grouped by the number of DAPs per case (0, 1, 2, 3, or $\geq$ 4), the odds of multiple DAPs in cases of FPH/SED compared with NPH/SED ranged from 2.89 (95% CI, 1.71-4.90) with 1 DAP to 24.55 (95% CI, 10.60-56.90) with $\geq$ 4 DAPs.

Conclusion: Cases of FPH/SED have more DAPs than NPH/SEDs.

Introduction

The identification of patients who may be difficult to intubate is a critical component of airway management in the air medical setting.[1] If these patients are identified early, air medical providers may elect to use an alternative airway with improved chances of success in a given patient population.[2-6] A variety of methods have been used to identify patients who may be difficult to intubate. Several scoring systems have been studied in the hospital setting and are predictive of difficulty preforming direct laryngoscopy and successful endotracheal intubation (ETI).[7,8] However, practical use of these scoring systems in the prehospital setting may be difficult because these patients are frequently unconscious or otherwise unable to follow instructions (thus preventing adequate preprocedure evaluation of the oral-pharyngeal opening or the quality of the laryngoscopic view).

Anatomic and physiologic criteria have been identified in the emergency department (ED) setting as predicting difficulty intubating and termed difficult airway predictors (DAPs). When present, these criteria predict difficulty intubating.[2,9] In previous research, we have reported that these criteria are common in cases of failed ETI, but we were unable to provide a frame of reference that would allow comparison with other groups of patients.[10] Given this background, our hypothesis was that individual DAPs are more common in cases of failed prehospital ETI with subsequent successful ED ETI (FPH/SED) than in cases with no prehospital ETI attempt and first-attempt successful ED ETI by a physician using direct laryngoscopy (NPH/SED), the gold standard used for this study. Furthermore, we hypothesize that if an individual DAP is more common in cases of FPH/SED the additive effect of those DAPs would make prehospital ETI even more difficult. Therefore, we expect that cases of FPH/SED will have more DAPs than cases of NPH/SED.

Methods

Study Design

We conducted a retrospective analysis of all patients in an ED ETI quality improvement database intubated over a 3-year period (July 1, 2007-June 28, 2010). This database included 2 subsets of patients: those intubated in the ED *without* a prehospital ETI attempt and those intubated in the ED *with* a FPH/SED attempt. This distinction was used to identify the 2 groups of patients for comparison in this study: 1) FPH/SED, patients with 1 or more failed prehospital ETI attempts but successfully intubated in the ED after arrival; and 2) NPH/SED, patients with no prehospital ETI attempt and intubated in the ED on the first attempt using direct laryngoscopy. This strict definition of NPH/SED was used to select a population that might most closely resemble patients successfully intubated in

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the prehospital setting because our ED ETI data set did not include these patients.

Data contained in the ED ETI quality improvement (QI) database were entered prospectively at the time ETI was preformed in the ED. The physician performing ETI in the ED completed a simple, 1-page data collection sheet; this data collection sheet was developed for data entry into a QI database. Both patients arriving by EMS as well as private vehicle were included. Patients arriving by EMS were transported to the ED from a broad spectrum of urban, suburban, and rural EMS agencies by both ground and air medical transport resources.

To identify any missing patient data forms, completed structured data collection forms were cross-referenced against professional billing records. If a patient intubation was identified without a completed form, the operator was sent a blank form for completion on that patient. This form documented the presence or absence of DAPs, whether ETI was attempted in the prehospital setting, the success or failure of ETI in the ED, and multiple other demographic and performance characteristics. Data were then entered into an Excel (Microsoft Corp, Redmond, WA) spreadsheet for grouping of patient populations and data analysis. The University of Arizona Institutional Review Board approved the retrospective analysis of these QI data.

Setting

This research study was conducted in a tertiary, urban, level-1 trauma center within a university medical setting with an annual ED census of approximately 50,000 patients. The majority of patients with prehospital ETI (or attempted ETI) received prehospital care from 1 of several fire-based prehospital agencies providing paramedic-level care or 1 of 5 helicopter emergency medical services (HEMS) that provide paramedic and flight nurse–level care. At the time of this study, 2 of the ground agencies and all of the HEMS agencies performed rapid sequence intubation (RSI). It was not possible to determine the proportion of patients in this data set who received prehospital RSI medications because these data were not included in the QI database used for this study.

During this study period, the standard of care was to perform prehospital ETI using only direct laryngoscopy. Primary ETI by video laryngoscopy, the use of an alternative airway, or bougie-assisted ETI was not standard practice in our EMS system. In early July 2010 (the end of the period encompassing this research study), many EMS agencies in our geographic region shifted to the routine use of an alternative airway within their airway management protocols.

In the ED, ETI is performed by emergency medicine residents (in postgraduate years 1-3) or pediatric emergency medicine residents (in postgraduate years 1-5) and under the supervision of emergency medicine attending physicians. Airway management in this ED is the ultimate responsibility of the emergency medicine attending physician (who determines, on a case-by-case basis, which resident will perform the intubation and the specific technique to be used).

Human Subjects

All patients requiring ETI in the ED were entered into the ED airway QI database. However, patients with successful ETI in the prehospital setting were not included in the database. Therefore, we performed a case-control analysis using 2 groups of patients (FPH/SED and NPH/SED). The first group, FPH/SED, was defined as any case presenting to the ED after an ETI attempt was made in the field but "failed" as indicated by the need for a prehospital rescue airway such as a "bag valve mask," the use of a supraglottic device, or cricothyrotomy. The second group, NPH/SED, was defined as a case in which a physician performed ETI using a direct laryngoscope with first-attempt success. For this analysis, cases of ETIs performed by nonphysicians (medical students) and ETI performed without a direct laryngoscope were excluded. Video laryngoscopy and other techniques were excluded because they were not available in the prehospital setting at the time of this study. In the ED, an attempt at ETI was defined as insertion of a direct laryngoscope into a patient's mouth without successful endotracheal tube placement in the trachea before removing the laryngoscope.

Measurement Methods

The QI data set used in this study includes demographic and clinical information (eg, sex, category of patient such as medical or trauma, and use of medications). Medication administration was categorized in the QI database as a paralytic and sedating agent, sedating agent alone, or no medication. The presence (or absence) of each DAP was recorded in each case at the time of patient care by the physician preforming ETI. The success or failure of ETI was the primary outcome measure.

For the purposes of this study, ETI in the ED was considered successful only if an endotracheal tube was placed on the first attempt. This high standard was chosen in hopes that NPH/SED cases would be as similar as possible to successful prehospital ETIs. Additionally, there is growing literature supporting an emphasis on first-attempt success to minimize adverse events associated with ETI.[11-13] Prehospital ETI was considered to have failed if the patient arrived in the ED after an attempted ETI (regardless of the number of attempts at ETI). We were not able to use the same first-pass success standard in our analysis because the ED ETI database did not include the number of prehospital attempts at ETI.

Primary Data Analysis

Data analysis was performed using Stata (version 12.1) software (Stata Corporation, College Station, TX). Descriptive statistics were then used to compare the prevalence of DAPs in the 2 groups. The odds ratio (OR) with 95% confidence intervals were calculated for the presence of each DAP in cases of FPH/SED compared with NPH/SED. The use of ORs to describe this relationship was chosen because this measurement best reflects the prevalence of DAPs in each study group.