Clinical paper

Techniques and outcomes of emergency airway management in Japan: An analysis of two multicentre prospective observational studies, 2010–2016☆

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ABSTRACT

Objectives: Continuous surveillance of emergency airway management practice is imperative in improving quality of care and patient safety. We aimed to investigate the changes in the practice of emergency airway management and the related outcomes in the emergency departments (EDs) in Japan.

Methods: We conducted an analysis of the data from two prospective, observational, multicentre registries of emergency airway management—the Japanese Emergency Airway Network (JEAN)-1 and -2 Registries from April 2010 through May 2016.

Results: We recorded 10,927 ED intubations (capture rate, 96%); 10,875 paediatric and adult patients were eligible for our analysis. The rate of rapid sequence intubation (RSI) use as the initial intubation method significantly increased from 28% in 2010 to 53% in 2016 ($P_{trend} = 0.03$). Likewise, the rate of video laryngoscope (VL) use as the first intubation device increased significantly from 2% in 2010 to 40% in 2016 ($P_{trend} < 0.001$), with a significant decrease in the rate of direct laryngoscope use from 97% in 2010 to 58% in 2016 ($P_{trend} < 0.001$). Concurrent with these changes, the overall first-attempt success rate also increased from 68% in 2010 to 74% in 2016 ($P_{trend} = 0.02$). By contrast, the rate of adverse events did not change significantly over time ($P_{trend} = 0.06$).

Conclusion: By using data from two large, multicentre, prospective registries, we characterised the current emergency airway management practice, and identified their changes in Japan. The data demonstrated significant increases in the rate of RSI and VL use on the first attempt and the first-attempt success rate over the 6-year study period.

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Introduction

Emergency airway management is a critical intervention in the emergency department (ED). The practice of emergency airway management has changed along with the evolution of intubation techniques and devices,[1–3] such as rapid sequence intubation (RSI)[1–11] and video laryngoscopes (VLs).[2,3,9,12–20] The performance of airway management with the use of these approaches is indicative of the competence of emergency physicians in the most advanced airway management for the critically ill.

A recent analysis of a large multicentre, observational study of North American EDs reported that RSI was used in 85% of emergency intubations between 2002 and 2012,[2] with an overall success rate on the first attempt of 83%. In contrast, a multicentre study in South Korea reported RSI use of 45% and first-attempt success rate of 81%.[13] Additionally, in our prior study in Japan, we found

RSI use of 20% and first-attempt success rate of 71%.[21] Furthermore, our prior study also demonstrated a high degree of variation in the methods of intubation and success rates across the EDs in Japan (e.g., the first-attempt success rate ranged from 40% to 83% in 2010–2011).[21] Although these prior studies reported the current practice of airway management in the ED, there are sparse data on the changes in practice over time.[2] Continuous surveillance of the airway management practice is important for improving quality of care and patient safety. In addition, as airway management is one of the most essential components of emergency medicine,[22] investigating the practice changes and related outcomes will inform the development of emergency medicine training and policy.

In this context, we aimed to investigate the changes in the practice of emergency airway management (methods and devices) as well as the related outcomes (intubation success and adverse events) in the Japanese EDs, by using large prospective, multicentre registry data collected from 2010 through 2016.

Methods

Study design, setting, and participants

This is a preplanned analysis of the data from two prospective, observational, multicentre registries of emergency airway management—the Japanese Emergency Airway Network (JEAN)-1 and -2 Registries.[6,21,23] These multicentre, prospective registries were designed to characterise the current emergency airway management across Japan. A complete description of the study methodology has been provided previously.[21,24–26]

In brief, JEAN-1 was initiated in April 2010 as a consortium of 13 academic and community medical centres from different geographic regions across Japan. The participating institutions included 11 Critical Medical Care Centres and had an average ED census of 25,000 patient visits per year (range, 4200–67,000). After the completion of JEAN-1 in March 2012, JEAN-2 was initiated in April 2012 expanding the consortium to 14 academic and community medical centres. Its participating institutions also included 11 Critical Medical Care Centres and had an average ED census of 31,000 patient visits per year (range, 14,000–66,000). Taken together, JEAN-1 and JEAN-2 consecutively enrolled adult and paediatric patients who underwent emergency airway management in one of the participating EDs from April 2010 through May 2016. All EDs of JEAN-1 and JEAN-2 participating centres were staffed by emergency attending physicians; all but one ED in JEAN-1 had affiliations with emergency medicine residency training programmes. In these observational registries, each ED maintained individual protocols about the procedures and policy for ED airway management. Intubations were performed by attending physicians, or by resident physicians at the discretion of attending physicians. The institutional review board of each participating institution approved the protocol with waiver of informed consent before data collection.

Data collection and processing

Data were collected prospectively for consecutive patients who underwent emergency intubation in the participating EDs. After each intubation, the intubator completed a standardised data collection form that included the patient's age, sex, primary indication for intubation, methods of intubation, devices and medications used, specialty of the intubators, number of intubation attempts, intubation success or failure, and associated adverse events.[21,24–26] An oral attempt was defined as a single insertion of a laryngoscope (or other device) past the teeth. For nasal intubations, an attempt was defined as a single insertion of an endotracheal tube past the turbinates.[1] Methods of intubation were categorised as follows: RSI, oral no medication, oral sedation only, and others. RSI was defined as oral intubation with virtually simultaneous administration of a sedative and a rapidly-acting neuromuscular blocking agent. "Oral no medication" was defined as oral intubation, in which no medications were used. "Oral sedation only" was defined as oral intubation, in which only sedative agents were used. An intubator was defined as a physician who attempted to pass an endotracheal tube past the vocal cords of a patient.[1] Specialty of the intubator was categorised as transitional-year resident, emergency medicine resident, emergency attending physician, and other. Transitional-year residents were postgraduate-year (PGY) 1–2 physicians who rotated through multiple specialties, including emergency medicine. An attempt was successful if it resulted in an endotracheal tube being placed past the vocal cords, with confirmation by quantitative or colorimetric end-tidal carbon dioxide monitoring.[1,3,21,25] Intubation-related adverse events included cardiac arrest, hypotension (systolic blood pressure less than 90 mmHg), hypoxemia (pulse oximetry saturation less than 90%), dysrhythmia, regurgitation, oesophageal intubation with delayed recognition, mainstem bronchial intubation, dental or lip trauma, airway trauma, and allergic reaction.[25] We monitored compliance with data form completion. Where the data collection form was missing, we interviewed the involved physicians and reviewed medical records to ascertain the airway management details. These post hoc interviews occurred within two weeks of the patient encounter.

Data analysis

This analysis included all adults and children who underwent emergency intubation from April 2010 through May 2016. First, to examine the changes in patient demographics, indication for intubation, methods and devices used to intubate, intubator's specialty, and adverse event rates, we constructed an unadjusted two-level hierarchical models with binomial response using random intercepts for the EDs to account for patient clustering within the EDs. Next, to determine the trends in intubation success rate on the first attempt, we also fitted a multivariable models adjusting for age, sex, primary indication for intubation, methods of intubation, devices, and specialty of the intubator. In the sensitivity analysis, we repeated the models stratifying by intubator's specialty, with a focus on emergency medicine residents. The analysis was conducted with JMP version 9.0.2 (SAS Institute Inc.; Cary, NC) and STATA 14.1 (StataCorp; College Station, Texas). We considered a two-sided $P < 0.05$ to be statistically significant.

Results

From April 2010 through May 2016, there were 11,333 patients who underwent emergency airway management in the EDs (Supplemental Fig. S1). Among these, the database recorded 10,927 intubations (capture rate, 96%). We excluded 52 patients with missing information on the specialty of the intubator and the date of intubation, and the remaining 10,875 patients were eligible for the analysis.

Overall, median age was 70 years (IQR, 54–80 years), 97% were adults (aged ≥18 years), and 38% were female (Table 1). Cardiac arrest accounted for 41% of the primary indication; medical indications accounted for 49% of intubations. RSI was the most frequently-used initial method, accounting for 41% of intubations in non-cardiac-arrest patients. For encounters in which an induction agent was used on the first attempt, midazolam (52%) and propofol (28%) were the common induction agents. Among neuromuscular-blocking agents for RSI, rocuronium (82%) was the