High Risk, Low Frequency: Optimizing Performance of Emergency Intubation for Children

Benjamin T. Kerrey, MD, MS*; Andrea Rinderknecht, MD; Matthew Mittiga, MD

*Corresponding Author. E-mail: benjamin.kerrey@cchmc.org.

0196-0644/$-see front matter

http://dx.doi.org/10.1016/j.annemergmed.2017.06.015

SEE RELATED ARTICLE, P. ■■■.

[Ann Emerg Med. 2017;■:1-4.]

Emergency intubation is a high-risk, low-frequency procedure for pediatric patients. Providers must perform emergency intubation for children competently and safely, yet exposure is rare for individual providers.[1-5] The infrequency of exposure creates substantial challenges for trainees and established providers, limiting opportunities to achieve and maintain competency, to develop a confident and comprehensive approach, and, for patients, to minimize the risk of adverse events.

Efficient placement of an endotracheal tube during the initial laryngoscopy attempt is a standard measure of procedural success. Compared with adults, for whom published rates of first-attempt success range from 75% to 83%,[6,7] emergency intubation for children is generally less successful, with rates ranging from 33% to 83% in the emergency department and ICU[8-14] and from 66% to 79% in the out-of-hospital setting.[15,16] Adverse events are also more common in children, with oxyhemoglobin desaturation reported in 33% to 47%[9,17] compared with 0.5% to 26% of adults.[6,7]

With efficient and safe intubation elusive for pediatric patients in a low-exposure environment, how do individuals performing this procedure respond?

THE GREATER SYDNEY AREA HELICOPTER EMERGENCY MEDICAL SERVICE APPROACH

In this issue of *Annals*, Burns et al[18] report that the Greater Sydney Area Helicopter Emergency Medical Service (GSA-HEMS) achieved a rate of success far higher than previously reported for pediatric patients undergoing emergency intubation. For 82 patients over the 64-month study period, GSA-HEMS providers self-reported an impressive 91% first-attempt success rate despite 77% of patients' having difficult airway indicators. Only 14% of patients had a documented adverse event, including 6% with oxyhemoglobin desaturation. The GSA-HEMS performance is more impressive in light of their infrequent exposure: fewer than 2 pediatric intubations per provider over 5 years.

TOO GOOD TO BE TRUE?

We should be cautious in interpreting studies of emergency procedures based on self-report or chart review. Several studies of emergency intubation suggest that self-report or chart review overestimates success and underestimates adverse events compared with video review or continuously measured vital signs.[19-23] The physician member of the 2-person GSA-HEMS team was responsible for completion of the data form and entering data into a clinical database, a process susceptible to multiple forms of bias and error. The risk of bias, however, was likely lower than in previous studies. Although the second GSA-HEMS provider was also susceptible to the same biases as the first, both members of the 2-person team had to approve the clinical documentation, implying agreement. In addition, although there were limitations to the data, agreement was excellent between the GSA-HEMS team's documentation and the measured vital sign data.

GENERALIZABILITY

As noted by Burns et al, we should also be cautious in generalizing their results to other patients and providers. The study sample included predominantly older children, and infants have been reported to be at significantly greater risk for both attempt failure and adverse events.[14,24] In a separate study of out-of-hospital emergency intubation for pediatric patients, first-attempt success was 66% and an adverse event occurred for 36% of subjects. In that study, median age was 2 years (interquartile range 0.4 to 6)[15] compared with 8 years (interquartile range 4 to 13) in the study by Burns et al.

Providers of emergency care to children have highly variable training, exposure, and work environments; for some, intubation is simply uncommon, whereas for others it may be performed once in a decade. In a

pediatric-specific setting, education and training for emergency procedures have been reported to be irregular at best, inadequate at worst.[25] The GSA-HEMS providers consisted of anesthesiology and emergency physicians and paramedics, all with devotion to practicing retrieval medicine in austere environments and all with greater concurrent experience with performing emergency intubation for adult patients than a provider would have in a pediatric-specific setting. The experience, motivation, and procedural skills of GSA-HEMS providers may be greater and not representative of all providers performing emergency intubation for children, especially those working in pediatric-specific environments.

OPTIMIZING PERFORMANCE OF THE LOW-FREQUENCY, HIGH-ACUITY PROCEDURE

We believe the GSA-HEMS performance represents truly superior outcomes despite the limitations of study design and sample. Many aspects of the GSA-HEMS approach (Table) are compelling and resonate with the best evidence available on improving the performance and safety of emergency procedures.

STANDARDIZATION

Standardization requires an explicit and accurate description of the desired process, leading to clear expectations and allowing enhanced recognition of

Table. Components of the GSA-HEMS approach to optimizing the performance and safety of emergency intubation.

Component	Description	Key Aspects
Standardization	Standard operating procedure and *Prehospital Emergency Anesthesia Manual*	Equipment layout ("kit dump") Team prebrief before induction Use of a bougie in every case to optimize first-look laryngoscopy success rate Confirmation of intubation by waveform capnography Strategies to minimize the risk of hypoxia: preoxygenation to at least 98% oxygen saturation, apneic oxygenation by nasal cannulae, use of a PEEP valve with BVM, and assisted ventilation before and after paralysis in hypoxemic patients Mandated use of ketamine to minimize the risk of hypotension Mandated use of rocuronium to reduce the need for redosing
Education, training, and assessment	Induction program Short-term supervised shifts until the individual is considered ready for independent practice Compulsory "currency" training and assessment	Online module on out-of-hospital rapid sequence induction, including video demonstration and self-assessment quizzes 1-wk clinical course: demonstrations, workshops, immersive simulations, a multistation objective structured practical assessment, and an animal cadaver procedural laboratory that included surgical airway maneuvers Unclear how this decision was made Every 3 mo for residents and every 6 mo for staff Online multiple-choice quiz testing knowledge of the standard operating procedure and manual Supervised run-through of a simulated RSI, pausing for discussion of predefined components of the system and rehearsal of practical components, including management of complications Pediatric scenarios are specifically discussed during currency training Supervising specialists use a structured form to conduct the currency assessment
Cognitive aids	Pediatric reference cards An RSI challenge-response checklist "Cold" intubation action card (no anesthesia or neuromuscular blockade)	Provide drug dosing, ETT sizing, and insertion depth based on patient weight or age, allowing cognitive offloading so that the team may focus on other aspects of the RSI Physician and paramedic will jointly use to cross-check their preparation immediately before induction Brief question-response checklist performed by the intubating provider and airway assistant together immediately before induction Identifies and checks that all equipment is ready and functional, verbalizes drug doses and a clear airway plan, including emergency surgical airway plan should intubation fail Used in the same manner as the checklist
Other	Monthly airway audit is presented at formal clinical governance meetings	Case discussion Key performance indicators presented, including first-attempt success

PEEP, Positive end-expiratory pressure; *BVM*, bag-valve mask; *RSI*, rapid sequence intubation; *ETT*, endotracheal tube.