

A Is for Airway: A Pediatric Emergency Department Challenge

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Regardless of the other myriad conditions we treat and services we provide, patients and society expect emergency physicians to be fully trained and prepared for the direst of emergencies. Major emergency department (ED) resuscitations typically begin with advanced airway management, and emergency physicians pride themselves in being expert at rapid sequence intubation. Mastery of this skill is a core mandate for our profession. "A is for airway."

In this issue, Kerrey et al¹ provide a disturbing reality check on this basic emergency medicine competency. In a meticulous analysis of videotaped rapid sequence intubations at a major academic children's hospital ED, they found limited effectiveness and many adverse events. The authors' brutal honesty is to be greatly respected, and their findings have important implications for us all.

Kerrey et al¹ found that half (52%) of the 114 children studied were intubated on the first attempt. No one working at a teaching hospital expects consistent first-time success for our trainees, but we don't expect such low odds either.

When first attempts were not immediately successful, how were airways then managed? Accordingly to Kerrey et al,¹ "In almost 25% of subjects, the duration of laryngoscopy on the first attempt, during which the patient was apneic and not receiving oxygen or ventilation, was over 1 minute." One fourth of children required 3 or more laryngoscopy attempts before correct endotracheal tube placement. One child underwent 9 intubation attempts. The median time from induction to endotracheal tube placement was 3 minutes, with one fourth of patients requiring 7.5 minutes or more for success. Rescue methods such as laryngeal mask airways were not used in any case.

What about adverse events? One third of the children in this study experienced hypoxemia during the intubation process; in 19% the desaturation was below 80%, and in 9% it was below 60%. Bradycardia complicated intubation in 4% of children. Two children (2%) became pulseless during the attempts and received intravenous epinephrine and chest compressions.

Most academic emergency physicians will regard this intubation performance as grossly discordant from their general experience. It certainly conflicts with previous reports of large case series of rapid sequence intubation,²⁻⁵ in which emergency

medicine residents demonstrated first-attempt success in 83% to 86% of adults^{4,5} and 77% of children,³ with complicating oxygen desaturation in 3% of adults² and 2% of children.³

How can we explain this discrepancy? Why are the results from Kerrey et al¹ so much poorer than those observed elsewhere?

One possible explanation is that children are simply more difficult to intubate than adults, given their smaller anatomy and often-large epiglottises. However, this is contradicted by the data from Sagarin et al,³ in which emergency medicine residents exhibited nearly the same first-attempt success in children³ as in adults.⁵ Additionally, anesthesia research has shown that difficult laryngoscopy is actually less frequent in children than in adults.⁶

A second rationale for these discrepant findings is that there might be something utterly anomalous about the practice patterns or training at the authors' medical center, making it unrepresentative of other similar institutions. Such a premise appears unlikely, however, because the study took place at a top-ranked and highly respected tertiary children's hospital with an unusually busy ED (90,000 visits annually) and a large (12 positions) pediatric emergency medicine fellowship. The ED boasts an array of notable academic faculty, with most (25 of 36) fellowship-trained in pediatric emergency medicine.⁷ There would appear to be no basis for assuming this pediatric ED to be any less expert than most; indeed, by all other measures they appear to represent a center of excellence.

A third and more convincing argument is differences in study methodology. Kerrey et al¹ reviewed resuscitation room videotapes of each intubation, rendering their results decidedly reliable and precise and setting a new criterion standard methodology for airway management research. Previous studies no doubt overestimate success because of their reliance on less trustworthy physician self-report or chart documentation. The degree of exaggerated success in the previous literature is unknown; however, it is unlikely to explain the bulk of the observed discrepancy, given that the practice experience of most academic emergency physicians more closely resembles that described in the literature²⁻⁵ and given that few would accept the premise that it is "normal" when intubating children to observe a 52% frequency of first-attempt success, a 33% frequency of hypoxemia, a 9% frequency of desaturation to less than 60%, and a 2% frequency of cardiac arrest.

If the airway management discordance between the study by Kerrey et al¹ and earlier studies cannot be primarily explained by age, institution, or study methodology, then one must consider the possibility that it relates to underlying differences in acuity and experience between a general ED and a pediatric ED. Divergent nonsequential educational paths have effectively created parallel but separate communities of general emergency physicians and pediatric emergency physicians. Because the groups are largely isolated from each other, their cultures and practice styles have in many ways evolved independently.

There are notable acuity differences between a general ED and a pediatric ED, with the latter demonstrating significantly fewer resuscitations and critical care procedures.^{8,9} General emergency medicine residents perform an average of 146 intubations during their training,¹⁰ rendering them substantial comfort with the procedural sequence, equipment, anatomic features, techniques for endotracheal tube placement verification, and strategies for backup management. Many adults have large epiglottises, so general emergency physicians have experience locating the vocal cords despite this hurdle. Although children represent a minority of their overall intubation experience, general emergency physicians can extrapolate skills honed and maintained in adults to these smaller patients.

Pediatric emergency physicians, on the other hand, can learn and refine their ED intubation skills only on the rare children who require the procedure, and even at high-volume children's hospital EDs, trainees are exposed to a low number of critically ill children.¹¹ In a 2008 survey, pediatric emergency medicine fellows reported performing a median of 3.5 intubations per year, with some reporting that they performed zero.¹² In a 2008 survey of pediatric ED directors, 62% reported that their volume of intubations was insufficient to maintain ongoing competency.¹³

This low-volume dilemma can be readily illustrated with data from the current article. The authors' ED treated 90,000 children over the 12-month study period, during which there were 145 total intubations (of which 123 were rapid sequence).¹ The program has 12 pediatric emergency medicine fellows, who performed just 21 of these intubations primarily. This averages to less than 2 intubations per fellow per year! During the fellows' 3 years of training, they would average barely 5 total primary ED intubations. And even if the program allocated half of all available rapid sequence intubations to their fellows (reserving the other half for their residents), this would still on average provide just 15 total ED intubations during the course of each fellow's 3 years of training. How can any fellow become expert in such a setting? If techniques and strategies for managing difficult airways are not used frequently enough, they cannot be retained and effectively applied.

We normally presume that subspecialists will be more skilled in their area than generalists, which naturally leads to a polarizing political question: Who is best qualified to intubate a child in an emergency? A pediatric emergency physician who

exclusively intubates children but does so only rarely (2 to 5 times per year, according to the above data) or a general emergency physician comfortable intubating adults who occasionally intubates children as well? Coming from 2 different training backgrounds and cultures, a vociferous division of opinion along party lines can be expected. Pediatric emergency physicians will favor their sole focus on children as a potent advantage. On the other hand, general emergency physicians treat the full spectrum of emergency patients may not feel that intimidated by those young healthy airways compared with their common adult fare of short necks, morbid obesity, facial fractures, and airways with pooled blood and vomit. The definitive answer to this question is, of course, unknown.

There are important lessons for all emergency physicians from this provocative and rigorous study. General EDs should carefully scrutinize and monitor their specific success with intubating children. Despite the relative rarity of this procedure, does their efficacy and safety experience closely mirror that for adults, or is it more like that observed by Kerrey et al?¹ If the latter, then why? Pediatric EDs should also scrutinize their own intubation success. Are they showing similar results to those of general EDs or results more like those of Kerrey et al?¹

Any ED finding evidence of substandard intubation performance must take concrete steps to address the deficiency. These should include the following:

- **Education.** Because airway management is paramount, make it an educational priority despite its relative rarity. Emergency medicine residencies have become veritable playgrounds of airway equipment (eg, laryngeal mask airways, video laryngoscopes), with ample hands-on training workshops. Pediatric emergency medicine fellowships should be nothing less. Training and practice in difficult airway algorithms and rescue devices should be routine. Expanding operating room experience may be essential to build confidence.
- **Exposure.** If practice exposure is rare, focus it where it is needed. Pediatric emergency medicine fellows and emergency medicine residents should always have first priority to perform intubations. Other trainees will not have primary responsibility for intubating in their careers and should not infringe on the experience of those who will. A surprising and unacceptable practice described in the study ED is that anesthesia providers primarily intubated almost half (11/25) of the trauma patients. Bloody, complex trauma airways are the best teaching cases of all and should be zealously reserved for any program's emergency medicine trainees. Most general academic EDs removed anesthesia providers from their trauma teams decades ago.
- **Culture.** When it comes to critical, potentially lifesaving procedures such as intubation, pediatric emergency physicians must embrace the aggressive culture of the full-spectrum emergency physician. When an airway must be secured, one must already know how to act, do it without hesitation, and have a well-thought-out backup plan should

that first attempt fail. Action must be instinctive and reflexive but not mindless.

It is unknown whether the suboptimal airway management observed at this one top-ranked children's hospital ED represents a practice anomaly or whether such deficiencies are widespread. Regardless, it suggests that a culture of command over airway management may not develop in locations with insufficient intubation volume. This landmark study by Kerrey et al¹ is a wakeup call for children's hospitals to ensure that all of their pediatric emergency physicians are truly "emergency physicians" in the sense that they are expert at airways and resuscitation. All of the amazing extras offered by a specialized pediatric ED will mean little if its physicians cannot intubate as quickly and expertly as those at the general ED just down the street. The first core mandate for an emergency physician is being an expert and proficient resuscitator. "A is for airway."

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REFERENCES

1. Kerrey B, Rinderknecht A, Geis G, et al. Rapid sequence intubation for pediatric emergency patients: higher frequency of failed attempts and adverse effects found by video review. *Ann Emerg Med.* 2012;●●:●●●.
2. Sakles JC, Laurin EG, Rantapaa AA, et al. Airway management in the emergency department: a one-year study of 610 tracheal intubations. *Ann Emerg Med.* 1998;31:325-332.
3. Sagarin MJ, Chiang V, Sakles JC, et al. Rapid sequence intubation for pediatric emergency airway management. *Pediatr Emerg Care.* 2002;18:417-423.
4. Levitan RM, Rosenblatt B, Meiner EM, et al. Alternating day emergency medicine and anesthesia resident responsibility for management of the trauma airway: a study of laryngoscopy performance and intubation success. *Ann Emerg Med.* 2004;43:48-53.
5. Sagarin M, Barton E, Ching Y, et al. Airway management by US and Canadian emergency medicine residents: a multicenter analysis of more than 6,000 endotracheal intubation attempts. *Ann Emerg Med.* 2005;46:328-336.
6. Heinrich S, Birkholz T, Ihmsen H, et al. Incidence and predictors of difficult laryngoscopy in 11,219 pediatric anesthesia procedures. *Pediatr Anesth.* In press.
7. Cincinnati Children's Hospital Department of Emergency Medicine. Meet the team. Available at: <http://www.cincinnatichildrens.org/service/e/emergency/team/>. Accessed February 20, 2012.
8. Green SM, Ruben J. Emergency department children are not as sick as adults: implications for critical care skills retention in an exclusively pediatric emergency medicine practice. *J Emerg Med.* 2009;37:359-368.
9. Green SM. Emergency department patient acuity varies by age. *Ann Emerg Med.* In press.
10. Hayden SR, Panacek EA. Procedural competency in emergency medicine: the current range of resident experience. *Acad Emerg Med.* 1999;6:728-735.
11. Chen EH, Cho CS, Shofer FS, et al. Resident exposure to critical patients in a pediatric emergency department. *Pediatr Emerg Care.* 2007;23:774-778.
12. Al-Eissa M, Chu S, Lynch T, et al. Self-reported experience and competence in core procedures among Canadian pediatric emergency medicine fellowship trainees. *CJEM.* 2008;10:533-538.
13. Losek JD, Olson LR, Dobson JV, et al. Tracheal intubation practice and maintaining skill competency: survey of pediatric emergency department medical directors. *Pediatr Emerg Care.* 2008;24:294-299.