

Advancing Patient Safety in Airway Management

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TRACHEAL intubation is a critical procedure that unites anesthesiologists as the definitive experts in the field of medicine. Not surprisingly, difficult airway management is the primary patient safety concern among anesthesiologists.¹ Decades ago, the introduction of pulse oximetry and end-tidal CO₂ were associated with a reduction in respiratory-related anesthetic death and brain damage.² In this issue of *ANESTHESIOLOGY*, Schroeder *et al.*³ shed light on recent trends in difficult airway management. Their findings suggest that we are making airway management safer. What remains to be studied is which advances in airway management have an impact on patient safety events.

The authors retrieved data from a quality improvement database to determine rates of difficult intubation (more than three attempts) or failed intubation (requiring surgical airway or wake up) across multiple community practices spanning a recent 14-yr period. Their primary question examined whether the rate of difficult or failed intubation decreased over time. They investigated an impressive 421,581 intubation procedures. During this time frame, they observed a steady decline in difficult or failed intubation and a fourfold decrease from the early period (2002 to 2009) to the late period (2009 to 2015) of the investigation. They offered a useful join-point analysis to determine inflection points of this decline. These findings are novel because they inform the community that we can, in fact, make a difference. Advances in intubation techniques and focus on human factors are unstudied interventions that may have influenced this observed difference. A dissection of the research design can help further inform the impact of these findings.

The study has some important limitations that have been appropriately addressed by the authors. First, despite a concerted effort to validate the self-reported database against anesthesia records, it remains possible that reporting patterns changed during the study period because it is impossible to confirm that every difficult intubation was appropriately captured. The study design leaves open the possibility that



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providers simply fatigued in their self-reporting of difficult airway events. Second, the study population was in one healthcare system with a predominantly care-team model. It is not clear whether results would be reproducible in other care settings or regions. However, the inclusion of 16 sites within the network helps validate their findings. Third, there was no single intervention during the study period that could be related to a negative deflection in the rate of events. Therefore, we are left with a poor understanding of what changes we can apply to our practice to expect similar improvement in safety. Finally, the primary outcome of difficult or failed intubation, although relevant, does not inform whether we have made real impact on the most concerning associated events of anoxic brain injury or death.

The observational study design chosen for this study enabled the group to research rare events that are difficult to investigate in a prospective randomized design. Observational data from registries and large data sets remain an effective tool to compare interventions to their associated outcomes. Work from the American Society of Anesthesiologists closed claims data set helped us determine that multiple attempts at intubation are associated with poor patient outcomes.⁴ Other observational studies have similarly informed the anesthesia community about strategies to manage the difficult airway. The United Kingdom's 4th National Audit Project was an enhanced observational study that prospectively examined airway management procedures across the country to capture key events in difficult airway management.⁵ This study group highlighted that poor airway planning, problems with aspiration, and failed rescue surgical airway management are important areas for attention. Subsequent edits to the Difficult Airway Society's guidelines for the management of the unexpected difficult intubation now address these observations.⁶ The Multicenter Perioperative Outcomes Group based in the United States has described the rare event of combined

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difficult bag-mask ventilation and difficult tracheal intubation.⁷ Predictors were identified and a description of successful airway management strategies were provided to help us better anticipate and manage this event. These important studies have informed the airway management community, but the study by Schroeder *et al.*³ takes another important step forward to inform the community that we *are* doing better.

So, why are we doing better? The most notable change during the study period has been the incorporation of video laryngoscopy during airway management. Several well designed studies have now confirmed that video laryngoscopy results in an improved intubation success rate for patients at risk of failure with direct laryngoscopy.^{8–11} Video laryngoscopy is also used most commonly to rescue failed direct laryngoscopy and is associated with a higher rescue success rate than alternative techniques.¹² These findings make it clear that when video laryngoscopy is feasible, it can serve to reduce the number of intubation attempts. With the growth of video laryngoscopy, there has likely been an associated decrease in the performance of awake flexible techniques. The airway management community remains concerned that our skill set has degraded with awake flexible techniques and that we have put our patients at risk by relying on video laryngoscopy. Although the study by Schroeder *et al.*³ did not compare the relative performance of airway management techniques, it appears that overall safety has improved in the era of video laryngoscopy. Future comparative investigations of intubation techniques stand to further inform how we may improve patient safety in airway management.

Perhaps the most important advance in airway management has been the training of anesthesiologists in emergency management skills. Residency training, initial board certification, and maintenance of certification in anesthesiology in the United States now require some form of crisis management training, often in the environment of simulation. I think we would all agree that attention to the medical decisions that occur during difficult airway management makes a difference in patient outcomes. Research has identified human factors as a key component of failed airway management and emphasized the need to focus on training.^{5,13} We have heeded the call to plan for difficult airway management, reduce the number of attempts at tracheal intubation, call for help early, avoid target fixation, and rehearse algorithms. Future research should study which elements of training in human factors can improve safety events. Interestingly, one of the most passionate calls for improvement in human factors training in airway management came from a voice outside of medicine. Martin Bromiley lost his wife Elaine, the mother of his two children, to failed airway management in 2005. Instead of focusing on anger and blame, he made

a call to anesthesiologists to be reflective about how they make decisions during difficult airway management through debriefing and learning.¹⁴ Mr. Bromiley, I hope that you find some comfort that your voice has been heard and perhaps we have moved to make airway management safer.

Competing Interests

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References

1. Stoelting R: Results of APSF survey regarding anesthesia patient safety issues. APSF Newsletter 1999; 13:6–7
2. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB: Trends in anesthesia-related death and brain damage: A closed claims analysis. ANESTHESIOLOGY 2006; 105:1081–6
3. Schroeder RA, Pollard R, Dhakal I, Cooter M, Aronson S, Grichnik K, Buhrman W, Kertai MD, Mathew JP, Stafford-Smith M: Temporal trends in difficult and failed tracheal intubation in a regional community anesthetic practice. ANESTHESIOLOGY 2018; 128:502–10
4. Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW: Management of the difficult airway: A closed claims analysis. ANESTHESIOLOGY 2005; 103:33–9
5. Cook TM, Woodall N, Frerk C; Fourth National Audit Project: Major complications of airway management in the UK: Results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: Anaesthesia. Br J Anaesth 2011; 106:617–31
6. Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhargava R, Patel A, O'Sullivan EP, Woodall NM, Ahmad I; Difficult Airway Society intubation guidelines working group: Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. Br J Anaesth 2015; 115:827–48
7. Kheterpal S, Healy D, Aziz MF, Shanks AM, Freundlich RE, Linton F, Martin LD, Linton J, Epps JL, Fernandez-Bustamante A, Jameson LC, Tremper T, Tremper KK; Multicenter Perioperative Outcomes Group (MPOG) Perioperative Clinical Research Committee: Incidence, predictors, and outcome of difficult mask ventilation combined with difficult laryngoscopy: A report from the multicenter perioperative outcomes group. ANESTHESIOLOGY 2013; 119:1360–9
8. Jungbauer A, Schumann M, Brunkhorst V, Börgers A, Groeben H: Expected difficult tracheal intubation: A prospective comparison of direct laryngoscopy and video laryngoscopy in 200 patients. Br J Anaesth 2009; 102:546–50
9. Malik MA, Subramaniam R, Maharaj CH, Harte BH, Laffey JG: Randomized controlled trial of the Pentax AWS, Glidescope, and Macintosh laryngoscopes in predicted difficult intubation. Br J Anaesth 2009; 103:761–8
10. Enomoto Y, Asai T, Arai T, Kamishima K, Okuda Y: Pentax-AWS, a new videolaryngoscope, is more effective than the Macintosh laryngoscope for tracheal intubation in patients with restricted neck movements: A randomized comparative study. Br J Anaesth 2008; 100:544–8
11. Aziz MF, Dillman D, Fu R, Brambrink AM: Comparative effectiveness of the C-MAC video laryngoscope *versus* direct laryngoscopy in the setting of the predicted difficult airway. ANESTHESIOLOGY 2012; 116:629–36

12. Aziz MF, Brambrink AM, Healy DW, Willett AW, Shanks A, Tremper T, Jameson L, Ragheb J, Biggs DA, Paganelli WC, Rao J, Epps JL, Colquhoun DA, Bakke P, Kheterpal S: Success of intubation rescue techniques after failed direct laryngoscopy in adults: A retrospective comparative analysis from the multicenter peri-operative outcomes group. *ANESTHESIOLOGY* 2016; 125:656–66
13. Flin R, Fioratou E, Frerk C, Trotter C, Cook TM: Human factors in the development of complications of airway management: Preliminary evaluation of an interview tool. *Anaesthesia* 2013; 68:817–25
14. Bromiley M: The husband's story: From tragedy to learning and action. *BMJ Qual Saf* 2015; 24:425–7

ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

Lyin' with a Lion: Deceptive Advertising for "Vitalized Air" Anesthetics



Soon after earning his D.D.S. in 1891 from the Ohio College of Dental Surgery, Dr. Charley D. Richey set up practice in York, Pennsylvania. From Ohio dentists, Richey had mastered how to extend nitrous oxide's anesthetic duration by supplementing it with trace amounts of alcohol and chloroform. By concealing his anesthetic's identity as "vitalized air" (bottom), he could reassure patients that they were not receiving nitrous oxide—the gas that many feared after reading press reports about laughing gas mishaps. "Vitalized air" reigned as a king of American dental anesthetics in the 1890s, so perhaps it made sense that Richey used the "king of beasts" (above) on one of his trade cards advertising the gas mixture. (Copyright © the American Society of Anesthesiologists' Wood Library-Museum of Anesthesiology.)

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