



The Current State of Airway Management: Are We Doing Better?

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Welcome to the special annual *Airway Management* issue from *Anesthesiology News*! Included in this issue are a variety of important airway topics and an airway management roundtable discussion of current airway-related controversies.

As patients become older, larger, and sicker, airway management remains an important aspect of anesthetic management. Although it is clear that the introduction of pulse oximetry and end-tidal capnography have improved respiratory monitoring and decreased the rate of injury and death,¹ complications related to airway management still remain a significant safety concern. We have many advanced airway devices and techniques at our command, yet complications still occur.

The number of cases performed outside the operating room (OR) requiring non-OR anesthesia (NORA) has steadily increased in both number and complexity. An additional challenge is the increasing age and disease severity of patients presenting for NORA. Two recent closed claims analyses demonstrated that airway management still contributes regularly to morbidity and liability. A recent article by Woodward et al reviewed the closed claims data related to NORA anesthesia.²



The majority of these claims (51%) occurred in the gastrointestinal (GI) suite and 89% were performed under monitored anesthesia care, without a secured airway. They found a significantly higher rate of death (62%) compared with anesthesia provided in the OR (30%). Adverse respiratory events were the most common cause of injury outside the OR, and the majority of these events involved inadequate oxygenation or ventilation. The authors concluded that improved monitoring could have prevented many of these adverse events.

Another study, by Ranum et al, examined the causes of liability in ambulatory surgery centers, and found that 19% of the high-severity claims involved respiratory complications.³ Inadequate monitoring of patients played a role in many of these complications as well. It is important to note that although monitored anesthesia care with sedation and a natural airway may appear to be safer than general anesthesia, close monitoring of ventilation and oxygenation is key to preventing complications, especially in high-risk patients. In addition, the lights are often dimmed or turned off, especially in areas such as the MRI or GI suite, making visual assessment of the airway and ventilation much more difficult.

A recent review found that airway complication rates may be decreasing, suggesting that we might be doing better. A study by Schroeder et al, published in *Anesthesiology*, retrospectively reviewed the rates of difficult and failed intubation in a large regional, community-based group anesthesia practice.⁴ They defined *difficult intubation* as more than 3 attempts, and *failed intubation* as the need to wake the patient or perform a surgical airway. Their database included more than 400,000 procedures from 2002 to 2015, and found a steady decline in both difficult intubation (from 6.6 to 1.6 per 1,000 cases) and failed intubation (from 0.2 to 0.06 per 1,000 cases).

In addition, they found a 4-fold decrease between the early (2002-2009) and late (2009-2015) periods studied. Although the exact causes of the reductions in this study were not reported or determined, it is reassuring to see this trend, and we can infer some potential reasons for these trends.

Steady Advances

A major change during the period studied by Schroeder et al was the introduction and widespread adoption of video laryngoscopy. Many studies have demonstrated the value of video laryngoscopes in a variety of settings, including difficult intubation, emergent intubation, and rescue of failed direct laryngoscopy.^{5,6} The availability of newer airway devices in the past decade, such as supraglottic airway devices and video laryngoscopes, has contributed to making airway management safer, enabling additional rescue techniques for both failed ventilation and failed direct laryngoscopy. More choice in airway devices translates to the ability to create more backup airway plans, but also requires regular training and practice on devices.

Another recent advance is the introduction of new devices to provide supplemental and apneic oxygenation during preoxygenation and airway management. John Sakles, MD, discusses the challenges of the physiologically difficult airway in this issue, wherein the challenges of oxygenation and ventilation, as opposed to intubation, are major factors.

The application of high-flow nasal oxygen during airway management to provide apneic oxygenation is not a novel concept,⁷ but several new devices have been introduced to the market to provide high-flow and even humidified oxygen. The Optiflow device (Fisher & Paykel Healthcare) can provide up to 60 L per minute of high-flow, humidified nasal oxygen during preoxygenation and airway management. The use of the transnasal humidified rapid insufflation ventilator exchange (THRIVE) technique has been demonstrated to prolong apnea time in difficult airway patients undergoing head and neck surgery. Patel and Nouraei used THRIVE to provide both preoxygenation and oxygenation during airway and surgical maneuvers that required prolonged apnea for as long as 17 minutes without desaturations below 90%.⁸ A recent article by Mir et al compared the use of THRIVE using the Optiflow device and standard

face mask preoxygenation in patients undergoing airway management via rapid sequence induction.⁹ The authors measured apnea time as well as arterial oxygen levels and found similar arterial oxygen levels in both groups, but longer apnea time in the THRIVE group.

Although this was a small study and not blinded to technique, it suggests that high-flow oxygenation is at least equivalent if not superior to face mask preoxygenation. There are other devices as well that can be used for apneic oxygenation: The SuperNO₂VA device (Vyaire Medical) is a nasal mask that delivers positive pressure and high-flow oxygen and can be maintained in place during intubation.

The NAP4 report, published in 2011, was a prospective observational study of airway management complications in the United Kingdom, which found that inadequate training, poor planning, and unavailability of necessary equipment were important causal factors in airway-related complications.¹⁰ As a result of these findings, the authors recommended increasing the use of guidelines and checklists, as well as implementing simulation and multidisciplinary training. They also recognized that human factors can play a role, especially in emergency airway scenarios.¹¹ A follow-up survey, conducted in 2013, by the NAP4 authors to assess the influence of the NAP4 report found that more than 60% of respondents were subsequently receiving training in human factors and crisis management.¹²

Awareness has increased during the past decade of the effect of human factors, such as situational awareness and fatigue, on provider performance and medical errors, especially during crisis situations. The widely publicized case of Elaine Bromiley in the United Kingdom played a significant role in increasing awareness of human factors related to airway management. In this case, a fixation error led to lack of recognition of a cannot-intubate, cannot-ventilate scenario. Lack of situational awareness and the team members' not speaking up during the emergency also played roles.^{13,14}

In the aftermath of the event, which resulted in hypoxic brain damage and withdrawal of care, the patient's husband, a commercial airline pilot, pressed for an investigation and brought increased awareness of systems and human-related factors to that country. He ultimately founded the Clinical Human Factors Group, which focuses on human factors in health care.¹⁵ Flin et al also analyzed reports associated with airway events in the NAP4 report and identified contributing human factors in all events.¹¹

In recent years, crisis management training, simulation, the importance of teamwork and multidisciplinary collaboration, and the role of human factors have become a part of training in medicine and anesthesiology.¹⁶ Simulation and training allows for the use of airway algorithms, creation and implementation of backup airway plans, and teamwork training, and may also be a reason why we may be doing better.

Simply having a variety of airway devices available is not enough; providers need to recognize how and when

to use them to maximize success. Cognitive aids have been shown to be useful in crisis situations; published difficult airway algorithms and mnemonics such as the Vortex approach can be used to guide emergency airway management.^{17,18}

As a result of the NAP4 report, the Difficult Airway Society and the Royal College of Anaesthetists created the Airway Leads Program. The role of the airway lead, an appointed position, is to standardize airway equipment, create policies for emergency airway

management, oversee airway audits, and arrange airway training and familiarity with guidelines.¹⁹

In the United States, the concept of multidisciplinary airway teams is spreading, too, with similar goals as the UK Airway Leads—standardization of guidelines and training, with a focus on team training, simulation, and crisis management.²⁰⁻²⁴ Several of these teams have demonstrated reductions in adverse airway events, also showing that we can, and are, doing better.^{20,22}

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