In Reply:

Thank you for providing an opportunity to respond to the interesting letters written by Drs. Cumberworth, Meyer and Eikermann, Austin and Lam, Caruso *et al.*, and Zhang *et al.* In our study, "Nondepolarizing Neuromuscular Blocking Agents, Reversal, and Risk of Postoperative Pneumonia,"[1] a small minority of patients (approximately 4%) had only a supraglottic airway device used during the case. Approximately 6% of patients included in our analysis were admitted postoperatively to the intensive care unit with an endotracheal tube in place. We did not formally adjust for these groups of patients in our analyses but agree that doing so may have strengthened our findings. Regardless of this potential improvement, based on our results, we agree with the sentiment that reversal of neuromuscular blocking agents should be both routine and guided by neuromuscular transmission monitoring (preferably quantitative). We appreciate that current national practices around neuromuscular monitoring are evolving and not uniform. National practice guidelines would help, as would additional refinements to the monitoring technology itself, given its immaturity. Our research group recently published an article outlining existing barriers and calling for the development of more robust, user-friendly neuromuscular monitoring technology.[2] Finally, we appreciate the comment regarding residual confounding in our propensity analysis. Although not included in table 1 of our article (Patient Demographics and Clinical Characteristics before and after Matching),[1] the rates of smoking and chronic obstructive pulmonary disease were similar between groups. We appreciate very much the interest in our work and hope that our findings will help raise attention to the importance of developing strategies to reduce postoperative pneumonia.

Competing Interests

The authors declare no competing interests.

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(Accepted for publication April 13, 2017.)

In Reply:

After a careful rereading of the letter from Drs. Meyer and Eikermann, we remain confused as to their objection to our editorial.[1] Their concern seems to be semantic in nature. In particular, they seem uneasy with the term *routine*. We think that they have ignored the basic message that we were attempting to make.

As stated in our editorial, neostigmine administration is not required once it has been determined that the train-of-four (TOF) ratio at the adductor pollicis has returned to a value of 0.90 or greater. This information can only be ascertained by using a quantitative neuromuscular monitor. Unfortunately, we suspect that the great majority of anesthesia practitioners still do not have access to these devices. What then is a clinician who only possesses a conventional peripheral nerve stimulator to do at the end of surgery when tactile or visual fade on TOF stimulation can no longer be detected?

It is our contention, in these circumstances, that the risk of respiratory complications from failure to reverse residual block far outweighs any theoretical adverse effects of neostigmine-induced "paradoxical paralysis." We are unaware of any documented clinical morbidity associated with the use of low-dose neostigmine (less than or equal to 0.04 mg/kg) even when administered at TOF values of 0.90 or greater.

Competing Interests

Dr. Murphy has served as a consultant for Merck & Co. (Kenilworth, New Jersey). The other author declares no competing interests.

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(Accepted for publication April 13, 2017.)

Assessing Success of Rescue Intubation Techniques after Failed Direct Laryngoscopy

To the Editor:

In a multicentered, observational study comparing the success rate of commonly used rescue intubation techniques after a failed direct laryngoscopy, Aziz *et al.*[1] showed that video laryngoscopy was associated with a higher success rate of rescue intubation and was more commonly used than other tools, including a fiberoptic bronchoscope, a supraglottic airway device, an optical stylet, and a lighted stylet. In addition to the limitations described in the discussion, however, there are several questions in this study that must be clarified.

First, the majority of rescue intubations (1,023 of 1,511 cases, 68%) were defined after one failed direct laryngoscopy attempt. This practice is not in agreement with the definition of difficult or failed laryngoscopy in the current practice guidelines for difficult airway management by the American Society of Anesthesiologists.[2] Because the authors did not provide the detailed causes of failed direct laryngoscopy, it was unclear why the anesthetists abandoned direct laryngoscopy after the first attempt. In fact, difficulty in performing laryngoscopy depends on the anesthetists' level of skill, the patient's features, and procedure circumstances. In this study, the authors did not specify whether an optimal-best laryngoscopy attempt was executed when a failed direct laryngoscopy was defined. The components of an optimal-best laryngoscopy attempt include a reasonably experienced (at least 3 full recent years) anesthetist, use of an optimal sniffing position, change of length or type of blade one time, and use of external laryngeal manipulation.[3] Only when an optimal-best laryngoscopy attempt is performed may difficult or failed laryngoscopy be readily obvious to an experienced anesthetist on the first attempt and thus is independent of both number of laryngoscopy attempts and time. According to the data provided by the authors, we cannot determine whether a definitively failed direct laryngoscopy occurs in each patient receiving rescue intubation.

Second, in this study, the failed direct laryngoscopy included the use of a device without a tube passage attempt, although the goal of direct laryngoscopy is to carry out tracheal intubation. It must be emphasized that the laryngeal view obtained by direct laryngoscopy is often used as an important variable for difficult or failed intubation, but they are not synonymous in most patients.[3] Successful intubation is dependent more on the skill level of the anesthetists than on the laryngeal view obtained by direct laryngoscopy, and thus the degrees of difficulty with direct laryngoscopy and tracheal intubation may be incompatible. For example, some patients with a class 3 or 4 laryngeal view may be successfully intubated by an experienced anesthetist on the first or second attempt if the distal end of the tracheal tube is suitably curved by a malleable stylet or an intubating introducer (*e.g.*, a gum-elastic bougie).[4] Actually, 61 of 1,619 patients with failed direct laryngoscopy in this study had a return to direct laryngoscopy again for airway rescue. Thus, when defining a failed direct laryngoscopy, the exclusion of a tube passage attempt is unreasonable.

Third, the success rate of rescue intubation with the supraglottic airway device was described as the final endpoint of performance. The final goal of airway management is maintenance of oxygenation rather than performing tracheal intubation. After a failed initial intubation attempt, restitution of ventilation by either a noninvasive (*i.e.*, supraglottic airway device) or an invasive intervention is the priority.[5] Thus, use of the supraglottic airway device as a rescue tool of failed direct laryngoscopy can not only provide a conduit to intubate the trachea but also is an effective ventilatory measure with a high success rate.[6] If the rescue intubation *via* the supraglottic airway device is unsuccessful, the existence of an effective airway can evidently be lifesaving. Thus, we argue that only comparing the success rate of rescue intubation using video laryngoscopy and a supraglottic airway device after failed direct laryngoscopy in this study is not a complete comparison.

Finally, video laryngoscopy provided a high success rate of rescue intubation after failed direct laryngoscopy but did not give a 100% success rate. This suggests that when attempting to rescue a failed direct laryngoscopy, no single device can address all issues. Furthermore, we agree with Hagberg *et al.*[5] that no one tool is better than others in all conditions, because each tool has individual properties that may be advantageous in some conditions but disadvantageous in others. The use of video laryngoscopy as the first rescue choice at the early stage of failed direct laryngoscopy seems rational,[7] but an important problem we are facing is what anesthetists should do if difficult video laryngoscopy occurs. In fact, recent work shows that first attempt failure at intubation using video laryngoscopy is also associated with increased complications.[8] Thus, we believe that to rescue a failed direct laryngoscopy expeditiously and safely, anesthetists must master the several different airway devices and should use the techniques with which they have the most experience and competence, with strict adherence to the current practice guidelines for difficult airway management.

Competing Interests

The authors declare no competing interests.

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(Accepted for publication April 9, 2017.)

Is Airway Management Better?

To the Editor:

The article by Aziz *et al.*[1] describes difficult airway management over a 8- to 9-yr period and analyzes the use and success of different airway devices for rescue after failed direct laryngoscopy. The authors found that video laryngoscopy was used most often and had the highest rate of success as a rescue tool (92%) compared to fiberoptic bronchoscopy, lighted stylets, optical stylets, and supraglottic airways (67 to 78% success rate). They speculate that the results may "reflect . . . widespread availability of video laryngoscopy, an anticipated high success rate, and growing comfort and familiarity with this technique." The authors state that the growing use of the video laryngoscopes, of which the GlideScope was used 83% of the time, is a "practice improvement." The attractiveness of video laryngoscopy is understandable as it is technically similar to direct laryngoscopy and, compared to other rescue techniques, may be easier to teach, learn, and master, perhaps fueling the increased use as highlighted in this article.

However, based on these data, we wonder whether there is an improvement in airway management or just a change in clinical practice and training. Moreover, we are concerned that this change in practice and training has resulted in a decriment in clinical skills. Despite its increasing use, the reported rate of failure of video laryngoscopy consistently ranges from 5 to 20%,[1–5] despite reports of improved view of the glottis.[5,6] The current investigation reports an 8% failure of video laryngoscopy as a rescue tool, at which time the practitioner used either fiberoptic bronchoscopy or direct laryngoscopy with or without bougie to rescue the rescue.[1] There are significant limitations to video laryngoscopy seen with small mouth opening, tongue and/or soft-tissue swelling (*e.g.*, infection, angioedema), altered neck anatomy (radiation, surgery, airway displacement, presence of a halo), and/or any airway obstruction.[1,4]

Despite reporting significant *P* values, the authors recognize the retrospective and unmatched nature of the study.[1] Important unknown variables include the reasoning for selection of a particular rescue airway device, which was at the practitioner's discretion. The equivalency of the patient's airways between the groups is not known. We do not know, for example, how many patients rescued with fiberoptic bronchoscopy had known predictors of failed video laryngoscopy. With regard to general conclusions of difficult airway management, the success of video laryngoscopy may have been artificially high if practitioners did not attempt to use video laryngoscopy if predictors of failure were present.

The authors did not discuss the 81% of the initial 7,259 cases that were excluded. Because the airway was ultimately secured with direct laryngoscopy, 40% of cases were excluded. In the other 41% (2,951 cases), another primary technique was used (*i.e.*, not direct laryngoscopy). There are no further data describing what technique was used nor how they were rescued. If consistent with the practice trends, then these initial "nondirect laryngoscopy attempts" would more commonly have included video laryngoscopy. If this were the case, then the success of video laryngoscopy is not accurately represented. Perhaps the failure rate of video laryngoscopy is significantly greater than 8%.

Airway trauma was reflected by the number of attempts made before the rescue attempt. The retrospective nature of the study precludes any conclusions regarding which technique was superior because there is no explanation as to how practitioners decided when "enough was enough." Furthermore, the only pharygeal and airway injuries (1% of total) reported in the present study occurred during use of video laryngoscopy. Finally, the present investigation reports an incidence of failed intubation of 2% (7,259 of 346,861), which is significantly higher than the 0.9%[7] or 0.1%[8] previously reported.

We do not refute the value of video laryngoscopy but want to emphasize the benefit of maintaining expertise with multiple airway management techniques. If teaching video laryngoscopy is overemphasized, then other skills will deteriorate. Prior investigations report success rates with fiberoptic bronchoscopy to be greater than 95%.[9,10] In another study of 100 cases of "unanticipated difficult airway," the practitioners reported a rescue success of 98% using a specific airway management algorithm that included adjustments in direct laryngoscopy, laryngeal mask airway, and a gum-elastic bougie.[7] These studies allude to the importance and impact of training.

There are limitations for each airway technique, and a failure to appreciate them will have adverse consequences. Aside from the video laryngoscope, no other device or class of devices were used in more than 9% of the study group.[1] Instead of showing a practice improvement, we are concerned that airway management, training, and education has declined as a result of reduced emphasis on becoming expert with multiple techniques to allow greater versatility in managing any airway.