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In Reply:

We thank very much Xue *et al.*, for their interesting letter concerning our recently published article in ANESTHESIOLOGY.[1] The remarks and questions are important and need some clarifications. Concerning the patients with Cormack and Lehane class I or II, it is right that most often these patients are, and were in our series, easy to intubate. But sometimes, as outlined by Xue *et al.*, the ease of direct laryngoscopy is not synonymous with ease of tracheal intubation. We encountered a difficult intubation in only 15 patients without any specific causes for their initial intubation failure.

Concerning the use of a stylet, our algorithm did not require the use of this device. We think that the gum elastic bougie (GEB) is more efficient and less traumatic than a stylet. We do not totally agree with Xue *et al.* that when the speed of tracheal intubation is important, a stylet should always be used. To our knowledge, no high-evidence–level studies support this statement. In the few studies that compared the stylet to the GEB, the GEB was more efficient and allowed intubation with a shorter time than did the stylet in difficult intubations.[2,3]

It is right that GEB is classically indicated only when the Cormack and Lehane class of laryngeal view is less than IV. However, we have already reported the potential interest of using GEB in patients with Cormack and Lehane class IV with a high intubation success rate.[4]

In our study, we used the reusable form of intubating Laryngeal Mask Airway (LMA) Fastrach™ (Laryngeal Mask Company Limited, San Diego, CA), not the intubating LMA CTrach™. We agree with Xue *et al.* that the intubating LMA CTrach™ is an excellent device and could have been used in our algorithm as a substitute for the intubating LMA Fastrach™. However, it has been reported that intubation through the intubating LMA CTrach™ needs more time than does intubation using the intubating LMA Fastrach™.[5] Moreover, the cost effectiveness of the intubating LMA CTrach™ is questionable when compared with that of the intubating LMA Fastrach™.[5]

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A Modified Difficult Airway Management Algorithm Incorporating Video Devices in Routine Anesthesia Practice

To the Editor:

The recent article of Amathieu *et al.*[1] that prospectively validated a modified difficult airway management algorithm incorporating video devices in routine anesthesia practice was of great interest to us. The authors should be congratulated for their excellent works in such a large cohort of anesthetized, paralyzed patients. However, there are several aspects of this study that should be clarified and discussed. We believe that such information would be helpful for others who would like to try this modified difficult airway management algorithm.

First, because authors did not provide the method of anesthesia induction used in this study, it was not clear whether the spontaneous breathing ceased when assessing facemask ventilation (FMV) before giving muscle relaxant in all patients with fewer than three adverse predictors. Moreover, if the amount of anesthetic is inadequate, airway spasm, a common cause of difficult FMV, can occur in response to irritation of the epiglottis and glottis from oropharyngeal or na-

sopharyngeal airway and secretions. In addition, when assessing FMV, authors should clearly describe whether all components of an optimal-best attempt at FMV, such as good mask seal, correct jaw thrust, optimal head and neck position, and use of proper size oropharyngeal or nasopharyngeal airway[2] had been achieved.

Second, this modified difficult airway management algorithm required the use of succinylcholine in patients with three or more adverse predictors during anesthesia induction and in those with grade III and IV difficult FMV after anesthesia induction. Also, authors found that the use of succinylcholine never worsened FMV quality in anesthetized patients, but rather improved it in most cases. Despite these positive results, we would still argue that in the patients with a recognized or questionable difficult airway, routine use of succinylcholine may not be the best opinion. Moreover, the decision whether to administer a muscle relaxant before endotracheal intubation (ETI) in the anesthetized patient really depends on many factors, such as ability of FMV, concrete situations of patients, and validity of rescue airway plans.[3] It should again be emphasized that continuous maintenance of adequate oxygenation throughout airway procedure is an exclusive core problem that the anesthesiologist must contend with to achieve various measures, because severe adverse outcomes including death or brain injury are caused by failure of oxygenation rather than failure of ETI.[4] ETI is only one of the measures used to maintain adequate oxygenation but can be never regarded as a final goal. Thus, we persevere that for patients with a recognized or questionable difficult airway, adequate FMV must be ensured before administering a muscle relaxant.[3] Moreover, if a patient presents significant difficult ventilation under an optimal-best attempt at FMV after anesthesia induction before muscle relaxant is given, a laryngoscopy attempt should be immediately performed to determine the ease of ETI. For an experienced anesthesiologist, an optimal-best attempt at laryngoscopy can be completed within 30–60 s. If the chances of achieving successful ETI are high (*i.e.*, a fairly good laryngoscopic grade), yet it is difficult to accomplish ETI because of no muscle paralysis, administration of succinylcholine may be appropriate.[2] However, if a difficult laryngoscopy (*i.e.*, grade III or IV laryngeal view) is obtained and ETI using direct or video laryngoscopy with use of gum elastic bougie fails, the rescue airway algorithm should be moved to the step that manages a "cannot intubate–cannot ventilate" situation; for example, immediate use of the LMA or LMA CTrach™ for emergency ventilation to reduce or avoid severe airway-related adverse outcomes.[5]

Third, this algorithm aimed to solve the ETI problems in patients with difficult airways, but the authors failed to report intubation time in all patients and apnea time in patients with difficult airways. We noted that a 90% end-tidal oxygen concentration (F_EO_2) was achieved with preoxygenation before anesthesia induction in all patients, but hypoxemia (oxygen saturation measured by pulse oximetry [Spo_2] <90%) and severe hypoxemia (Spo_2 <80%) episodes still occurred in 87 and 17 patients, respectively. Also, most of the severe hypoxemia episodes occurred during failed intubation with either direct or Airtraq laryngoscopes (Prodol Meditec S.A., Vizcaya, Spain). A computer model describing the rate of oxyhemoglobin desaturation during apnea reveals that, when a preapnea F_EO_2 is 87%, apnea times required for Spo_2 to decrease to 80% is 8.7 min in a 70-kg adult patient and 3.1 min in a 127-kg obese patient, respectively.[6] This model has been found to agree reasonably well with actual data from patients whose weight and degree of normalcy and preoxygenation are reliably known.[7–9] Based on these data, we deduce that apnea time by ETI procedure in this study is at least 3 min in the morbidly obese patient with severe hypoxemia, and is longer than 8 min in the nonobese patient with severe hypoxemia. The transient episode of severe hypoxemia by prolonged ETI procedure does not cause adverse outcomes in health patients, but may become a problem in elderly patients with ischemic heart or brain diseases. Also, a prolonged ETI procedure can increase the risks of airway injury and pulmonary aspiration.[3,10] To ensure patient safety, therefore, we advise that the notion as to the reasonable time limits of ETI procedure with direct and Airtraq laryngoscopes should be added to this algorithm. This is especially important for patients with decreased apnea tolerance, such as morbidly obese patients, elderly patients, patients with lung diseases, and pregnant women.[9]

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Questioning Succinylcholine Usage in Grade IV (Difficult) Mask Ventilation

To the Editor:

We read with great interest the article by Amathieu *et al.*[1] "An Algorithm for Difficult Airway Management, Modified for Modern Optical Devices (Airtraq Laryngoscope; LMA CTrach®): A 2-yr Prospective Validation in Patients for Elective Abdominal, Gynecologic, and Thyroid Surgery."

We appreciate the efforts of the authors in their attempt to identify a new difficult airway algorithm in this era of video laryngoscopes, which are proposed to be useful in difficult airway scenarios with or without failed conventional laryngoscopy. We would like to discuss a few important issues with respect to this study.

First, being a difficult airway algorithm, the route of induction (inhalational/intravenous) used in this study and recommendations in the algorithm have not been clearly mentioned. These findings would be of special concern in morbidly obese patients with obstructive sleep apnea syndrome and in patients with more than three difficult airway predictors.

Second, the authors have mentioned that with mask ventilation difficulty grade III/IV, succinylcholine will be used to reduce the duration of apnea. Because grade IV mask ventilation is being described as ventilation inadequate with no end-tidal carbon dioxide measurements and no predictable chest wall movement during attempts at positive pressure ventilation, it is inadvisable to paralyze the patient as per the author's algorithm, and this process goes against the universally practiced American Society of Anesthesiologists difficult airway algorithm, which insists on preservation of ventilation. If ventilation is not possible according to the American Society of Anesthesiologists algorithm, it is better to awaken the patient rather than primarily paralyzing the patient.

Third, the algorithm only mentions that in patients with three or more predictors of difficult airway succinylcholine will be used primarily. The authors have not clearly mentioned the upper limit with respect to the number of predictors of difficult airway within which the patient will be anesthetized and paralyzed primarily with succinylcholine or above which the patient will be excluded from the study and will undergo fiberoptic intubation while awake. In this study, one patient who had five difficult airway predictors was anesthetized and paralyzed with muscle relaxant succinylcholine (primarily) and desaturated up to 68%. Whether to anesthetize or to proceed with fiberoptic intubation in the awake patient in higher difficult airway predictors is an important issue of concern.

Fourth, although Airtraq has been used as a familiar videolaryngoscope, the use of a gum elastic bougie with Airtraq is not that familiar to anesthesiologists. There are few articles[1,2] that describes the use of bougie-aided intubation with Airtraq (including the current study), but nowhere in the literature has the methodology of gum elastic bougie usage with Airtraq been explained clearly.

The authors have intubated three patients with Airtraq with the aid of gum elastic bougie. The following queries are unanswered:

1. In Cormack Lehane grade III/IV view with Airtaq, was gum elastic bougie used blindly?
2. Was the bougie passed through the already loaded endotracheal tube in the endotracheal tube channel of Airtraq?
3. Was it possible to manipulate the distal tip of the gum elastic bougie when it was already loaded in the endotracheal tube?
4. If gum elastic bougie was used without an endotracheal tube through the endotracheal tube channel, was it determined whether further endotracheal tube railroading is through the endotracheal tube channel or outside it?

Being the first rescue device in the difficult airway algorithm described, a description of the methodology of usage of gum elastic bougie with Airtraq would have been equally or more important than description in the algorithm alone because it has not been described anywhere else in the literature. We will be very glad if the authors take into consideration the above-mentioned issues.

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