Organizational Aspects of Difficult Airway Management

Think Globally, Act Locally

IN 1858, Eugène Bouchut, a pediatrician from Paris, published a series of seven cases of successful orotracheal intubation to bypass laryngeal obstruction resulting from diphtheria.[1] His presentation was reportedly not well received by the French Academy of Sciences because of safety concerns. Today, millions of tracheal intubation procedures are performed every year, and in emergent situations, the procedure still carries a high risk of complications of up to 30%. Accordingly, new information that could potentially lead to improved outcome of tracheal intubation is important. In this issue of ANESTHESIOLOGY, four groups of clinical researchers [2–5] present important new insight that might help improve the safety of patients undergoing emergency tracheal intubation. The work of Combes *et al.*[2] and Martin *et al.*[3] focused on emergent intubation, whereas Amathieu *et al.*[4] and Aziz *et al.*[5] report on their experiences with new devices to manage a difficult airway in the operating room.

It is challenging to develop guidelines for tracheal intubation that are widely aphoristic because the clinical scenarios leading to tracheal intubation attempts, as well as the available equipment, are diverse. Although National Anesthesia Societies conclude that standards of practice and monitoring in a prehospital setting should be the same as an in-hospital tracheal intubation,[6] this does not reflect real-world reality, where the conditions under which a patient requires anesthesia for intubation vary widely. Tracheal intubations, even in the most affluent parts of the world, are being performed by healthcare providers with different training backgrounds, such as paramedics, emergency department nurses, respiratory therapists, and physicians of different specialties. In addition, the available equipment and peer support differ between a tertiary care hospital operating room and a preclinical intubation in the field. Finally, the acuity and nature of a patient's disease vary depending on the clinical scenario (preclinical, emergency department, intensive care unit, or operating room), which in turn affects the strategic planning of airway management. Accordingly, guidelines developed for anesthesiologists in the operating room[7] cannot be reasonably applied to emergent intubation in the field.

What Does the Work of Martin *et al.*, Combes *et al.*, Aziz *et al.*, and Amathieu *et al.* Add to the Existing Literature?

Emergency Intubation

The two articles by Combes *et al.* and Martin *et al.* discussed in this editorial[2,3] show the benefits and limitations of a locally developed, standardized approach to airway management. Combes *et al.*[2] developed a very specific algorithm for unanticipated difficult airway management in the prehospital emergency setting. The use of this algorithm was associated with a very high (more than 99%) success rate of emergent management of patients with difficult airways. The authors are to be commended for this accomplishment, which may help save the lives of future patients. We believe that all organizations responsible for prehospital resuscitations should develop a local algorithm for use by their specific providers. This suggestion is supported by a basic principle of performance improvement initiatives: these initiatives need to fit into local culture.

The flip-side of this conclusion implies that any locally developed, specific algorithm[2] needs to be substantially modified to fit in any other clinical scenario. The algorithm of Combes *et al.*[2] may not work very well outside of the Service de Medecine d'Urgence et de Reanimation of the Henri-Modor University Hospital in Creteil, France, which reportedly consists of a skilled team of three people—a senior physician, a nurse anesthetist, and an experienced medic/ambulance driver. This ideal skill set probably does not represent an average approach to preclinical emergency medicine outside of Paris.

The highly trained preclinical airway team of Combes *et al.* and the sophisticated in-hospital airway emergency response team of Martin *et al.* reported a high success rate for tracheal intubation. In addition, Martin *et al.* reported a 2.3% complications rate in 2,400 intubations. We find the latter results impressive as well as far less than published data. The lower complication rate in the study by Martin *et al.* compared with the study of Combes *et al.* can possibly be explained by the different study design (retrospective *vs.* pro-

◆ This Editorial View accompanies the following four articles: Amathieu R, Combes X, Abdi W, El Housseini L, Rezzoug A, Dinca A, Slavov V, Bloc S, Dhonneur G: An algorithm for difficult airway management, modified for modern optical devices (Airtraq™ laryngoscope; LMA CTrach™): A 2-year prospective validation in patients for elective abdominal, gynecologic, and thyroid surgery. ANESTHESIOLOGY 2011; 114:25–33; Aziz MF, Healy D, Kheterpal S, Fu RF, Dillman D, Brambrink AM: Routine clinical practice effectiveness of the glidescope in difficult airway management: An analysis of 2,004 glidescope intubations, complications, and failures from two institutions. ANESTHESIOLOGY 2011; 114:34–41; Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S: 3,423 emergency tracheal intubations at a university hospital: Airway outcomes and complications. ANESTHESIOLOGY 2011; 114:42–8; Combes X, Jabre P, Margenet A, Merle JC, Leroux B, Dru M, Lecarpentier E, Dhonneur G: Unanticipated difficult airway management in the prehospital emergency setting: Prospective validation of an algorithm. ANESTHESIOLOGY 2011; 114:105–10.

Accepted for publication October 6, 2010. The authors are not supported by, nor maintain any financial interest in, any commercial activity that may be associated with the topic of this article.

 Anesthesiology 2011; 114: 3–6

spective). In addition, this may be related to the high skill level of their team composed of a senior and a junior anesthesia resident, working with an attending backup.[3] In accord, we also observed in our department that supervision by an attending anesthesiologist is associated with a decreased incidence of complications during emergent intubations.[8]

How to Use New Optical Devices for Emergency Intubation Optimally

An anticipated difficult airway for a surgical procedure should ordinarily be secured with the method that allows the highest success rate as well as the lowest morbidity. To date, fiberoptic intubation of the spontaneously breathing patient is the gold standard for elective anticipated difficult airway intubation. Video laryngoscopy (*e.g.*, Glidescope, Verathon, Bothell, WA; Airtraq™, Prodol Meditec S.A., Vizcaya, Spain; LMA Ctrach™, The Laryngeal Mask Company Limited, Le Rocher, Victoria, Mahe, Seychelles), has recently become widely available and used successfully in studies including patients with a difficult airway. It is possible that this technique emerges as a potential alternative to fiberoptic intubation in selected cases.

Aziz *et al.* performed a cohort study based on data on file from two different institutions to define risk factors of intubation failure. The Glidescope was used in 2,004 of 71,570 cases. Success for Glidescope intubation after failed direct laryngoscopy was 94%. Variables associated with Glidescope-guided intubation failure were related to altered neck/pharyngeal anatomy.

Amathieu *et al.* used their 6-month clinical experience with Airtraq™ and LMA CTrach™ devices to incorporate the use of these devices in a locally developed algorithm for difficult airway management. The available equipment, in combination with the prospectively defined algorithm, allowed at the authors' institution successful tracheal intubation in all 12,221 patients presenting for elective surgery.

How Can We Build on These Milestones? Think Globally Act Locally!

To improve the outcome of patients considered for tracheal intubation, clinicians and scientists should be encouraged to think globally and act locally. We need to focus on the global goal of how to improve patients' long-term outcome, taking into account the specifics of the local facility.

Act Locally: How Should a Specific Algorithm Be Developed and Validated?

Algorithms are schematic models of the clinical decision pathway described in a guideline. The most successful algorithms and performance improvement measures have been developed on a local level by a multidisciplinary team. In general, the following steps are followed: (1) Identifying the problem, (2) selecting areas of performance improvement, (3) testing the strategy for change, (4) assessing data to determine whether performance is improved, (5) creating plans to implement improvement throughout the system, and (6) continuing to monitor effectiveness and make changes as needed. The excellent work of Martin *et al.*, Combes *et al.*, Aziz *et al.*, and Amathieu *et al.* was helpful in that context. Their local action report developed by local experts provided us with useful information on how to act successfully at a local level to accomplish an emergency intubation.

Martin *et al.*, Combes *et al.*, Aziz *et al.*, and Amathieu *et al.* all identified a problem and selected areas for performance improvement. In addition, Combes *et al.* and Amathieu *et al.* tested a strategy for change. Although none of the studies shows scientific proof as to whether or not performance has been improved (they did not perform a rigorous validation study), all groups created a plan to further improve their performance. Accordingly, the studies presented in this issue of ANESTHESIOLOGY are good examples of how to act locally toward developing specific algorithms for emergency airway management.

Factors that need to be addressed locally relate to the collection of patients under consideration, the availability of equipment, and the skill levels of the operators, taking into account their experience with the available equipment. For example, a bougie was used in the studies of Combes *et al.* and Martin *et al.*, and it worked very well. It is possible that their low complication rate related to emergency intubation is related to the use of a bougie. However, we are not aware of any other study showing that the use of a bougie decreases the esophageal intubation rate in emergent intubations outside of the operating room. On the other hand, severe complications, such as pharyngeal wall perforation, have been reported with its use, and we are therefore not entirely convinced that the device should be used routinely. However, the combination of high success of emergency intubation combined with a low complication rate suggests that the gum elastic bougie works well given the skill levels of the operators in Ann Arbor, Michigan and Paris, France.

Think Globally: Interventions to Improve the Outcome of Patients Considered for Tracheal Intubation

Regarding the global aspect of difficult airway management, we should not start with the (important) consideration of how to handle an unexpectedly difficult intubation. It is imperative to keep in mind other variables that affect the outcome of patients presenting with a disastrous impairment of cardiopulmonary function. In fact, even in patients who suffer cardiac arrest, some data make us uncertain as to whether or not tracheal intubation significantly improves their outcome.[9]

A specific algorithm representing the decision points with yes or no nodes on how to improve the outcome of patients considered for tracheal intubation in a variety of clinical scenarios cannot be developed. It would be too specific to be helpful to clinicians for decision-making in precise circumstances.

Based on the thoughts of Jaber *et al.*,[10] who recently described an intervention to decrease complications related to

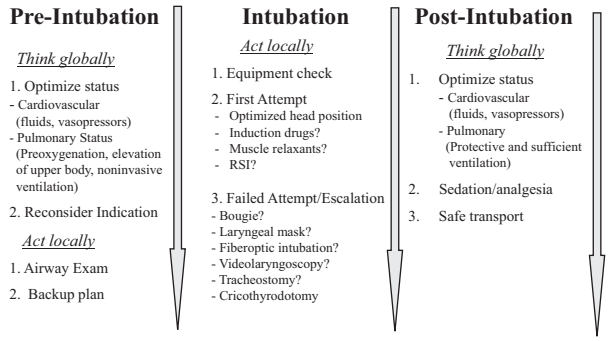

Fig. 1. Considerations to improve the outcome of patients considered for endotracheal intubation. A time domain needs to be included in the clinical decision-making process on emergency airway management. Before intubation, the clinician should focus on using the best possible evidence for making a decision about whether or not the tracheal intubation is really indicated. Any algorithm for emergency intubation needs to take into account a local worst-case scenario. In addition, an equipment check seems to be mandatory, and a specific (locally applicable) strategy for difficult intubation should be developed. After tracheal intubation and confirmation of adequate tube position, the healthcare provider's focus should be on how to maintain cardiopulmonary stability without harming the patient by inadequate sedation or analgesia and mechanical ventilation. RSI = rapid sequence induction.

tracheal intubation in the intensive care unit, we believe that a time domain needs to be included in the clinical decision-making process of emergency airway management. Before intubation (fig. 1), the clinician should focus on using the best possible evidence for making a decision as to whether or not the tracheal intubation is really indicated. If yes, then the plan for performance of intubation needs to be made, taking into account a local worst-case scenario. As for the intubation procedure, an equipment check seems to be mandatory, and a specific (locally applicable) strategy for difficult intubation needs to be anticipated. After tracheal intubation and confirmation of adequate tube position, the focus of the healthcare provider should be on how to maintain cardiopulmonary stability without harming the patient by inadequate sedation or analgesia and invasive ventilation.

Which Factors Should be Taken into Account to Think Globally?

As for the question of how to manage a difficult airway by using new video-assisted devices, many questions remain open. More than a dozen products, some modeled on the familiar Macintosh blades and others quite unique, are currently being marketed. It is probably impractical for anyone but the most motivated individual to buy and gain expertise in all of them. Will video capability become available routinely as a first alternative to direct laryngoscopy? Perhaps, but as of January 2011, the available data are insufficient for making predictions in this regard. Each video-assisted airway device has specific advantages and disadvantages, and the studies published in the field are mostly sponsored by the manufacturers. We need to know whether or not the success rate of video-assisted tracheal intubation is higher compared with a regular Macintosh laryngoscope. A prospective, randomized controlled trial comparing the two techniques should be conducted. Given the low rate of airway-related complications and high sample size, multicentric studies are probably required.

In addition, the Society of Anesthesiologists guidelines as preoperative risk factors for a difficult intubation should be investigated with the use of these devices: (1) relation of maxillary and mandibular incisors during normal jaw closure—micrognathia or overbite, (2) interincisor distance-mouth opening (less than 30 mm), (3) visibility of uvula—Mallampati Class, (4) compliance of the mandibular space, (5) thyromental distance, (6) length of neck, (7) thickness of neck, and (8) range of motion of head and neck.

As for emergency intubation, we should focus our global way of thinking on the long-term outcome of our patients. Outcomes research seeks to understand the end results of particular healthcare practices and interventions. End results include effects that people experience and care about, such as change in the ability to function. In this context, a global way of thinking about emergency airway management requires us to focus our attention on relevant variables, such as mortality, intensive care unit and hospital length of stay, and the incidence of important clinical events such as stroke and myocardial infarction. In addition, functional measures taken after hospital discharge (*e.g.*, SF-36, a 36-item health survey) should be incorporated in future studies.

One big challenge is to educate and train healthcare providers in the specific critical care decision-making processes required to optimize the outcome of patients considered for emergent intubation. International societies, such as the American College of Surgeons and the Society of Critical Care Medicine, offer courses that include simulation to help provide expert care in emergencies.

Although the ultimate goal of uniform expert care may not easily be attainable, a combination of specific local treatment algorithms and academic projects encouraging clinicians to think more globally about patient outcome might get us closer to the goal of providing optimal patient care to those considered for difficult airway management.

Ulrich Schmidt, M.D., Ph.D., Matthias Eikermann, M.D., Ph.D., Department of Anesthesia, Critical Care, and Pain Medicine, Massachusetts General Hospital and Harvard Medical School, Boston, Massachusetts. meikermann@partners.org.

References

1. Bouchut E: D'une nouvelle méthode de traitement du croup par le tubage du larynx. Bull Acad Med Paris 1858; 23: 1160–2
2. Combes X, Jabre P, Margenet A, Merle JC, Leroux B, Dru M, Lecarpentier E, Dhonneur G: Unanticipated difficult airway management in the prehospital emergency setting: Prospective validation of an algorithm. Anesthesiology 2011; 114: 105–10
3. Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S: 3,423 emergency tracheal intubations at a university hospi-

tal: Airway outcomes and complications. ANESTHESIOLOGY 2011; 114:42–8

4. Amathieu R, Combes X, Abdi W, El Housseini L, Rezzoug A, Dinca A, Slavov V, Bloc S, Dhonneur G: An algorithm for difficult airway management, modified for modern optical devices (Airtraq™ Laryngoscope; LMA CTrach™): A 2-year prospective validation in patients for elective abdominal, gynecologic, and thyroid surgery. ANESTHESIOLOGY 2011; 114:25–33
5. Aziz MF, Healy D, Kheterpal S, Fu RF, Dillman D, Brambrink AM: Routine clinical practice effectiveness of the Glidescope in difficult airway management: An analysis of 2,004 Glidescope intubations, complications, and failures from two institutions. ANESTHESIOLOGY 2011; 114:34–41
6. Jensen AG, Callesen T, Hagemo JS, Hreinsson K, Lund V, Nordmark J: Scandinavian clinical practice guidelines on general anaesthesia for emergency situations. Acta Anaesthesiol Scand 2010; 54:922–50
7. American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. ANESTHESIOLOGY 2003; 98:1269–77
8. Schmidt UH, Kumwilaisak K, Bittner E, George E, Hess D: Effects of supervision by attending anesthesiologists on complications of emergency tracheal intubation. ANESTHESIOLOGY 2008; 109:973–7
9. Stiell IG, Wells GA, Field B, Spaite DW, Nesbitt LP, De Maio VJ, Nichol G, Cousineau D, Blackburn J, Munkley D, Luinstra-Toohey L, Campeau T, Dagnone E, Lyver M, Ontario Prehospital Advanced Life Support Study Group: Advanced cardiac life support in out-of-hospital cardiac arrest. N Engl J Med 2004; 351:647–56
10. Jaber S, Jung B, Corne P, Sebbane M, Muller L, Chanques G, Verzilli D, Jonquet O, Eledjam JJ, Lefrant JY: An intervention to decrease complications related to endotracheal intubation in the intensive care unit: A prospective, multiple-center study. Intensive Care Med 2010; 36:248–55