Continuing Medical Education

Advances in airway management

[Le landiolol et l'esmolol préviennent la tachycardie sans altérer le débit sanguin cérébral]

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Airway module overview

Fortunately, a difficult airway is uncommon. However, its occurrence is often associated with significant adverse respiratory events.[1] While it is prudent to use clinical evidence to develop airway management strategies to improve patient outcome,[2–4] few randomized double-blind controlled clinical trials are available to evaluate specific airway approaches, techniques or devices. Most randomized clinical trials examining airway techniques or devices involve a number of patients too small to have sufficient statistical power to draw valid conclusions to guide the management of an uncommon difficult airway. Almost all of the current clinical evidence in airway management consists of case reports, case series, reviews and editorials. While there are limitations in drawing conclusions from these publications, they often provide the best evidence upon which critical decisions in airway management are based. The purpose of this Continuing Education Module is to provide a self-directed learning process to review new developments in airway management and devices, as reported in this journal and others. We hope this update will influence readers' approach when confronted with new airway devices and airway challenges, and ultimately, improve patient outcome.

Airway assessment

All airway management must begin with a proper airway assessment. In our recent editorials in this Journal, we stressed the importance of assessing a patient for *'ventilatability'* and not just *"intubatability"*.[5,6] Thus, in addition to asking the question "Can I intubate this patient's trachea using direct laryngoscopy or an alternative intubation technique, including surgical airway?" we should ask "Can I ventilate and oxygenate this patient using a bag-valve mask, or an extraglottic device?" Prediction of a difficult direct laryngoscopy using the Mallampati classification and a combination of other airway measurements[7] has been well studied. For many anesthesiologists, predicting difficult laryngoscopy and intubation was the only aspect of the airway examination emphasized during residency training. Appropriately, more recent work has focused on the predictors of difficult bag-valve mask ventilation. Presence of a beard, obstructing airway pathology, a history of snoring, obesity, absent dentition, and advancing age have all been correlated with difficult bag-mask ventilation.[5,8] Extraglottic devices such as the **Laryngeal Mask Airway** (LMA; LMA North America, San Diego, CA, USA), **Esophageal-tracheal Combitube** (Kendall Healthcare, Mansfield, MA, USA) and **Laryngeal Tube™** (King Systems Corporation, Noblesville, IN, USA) are all effective rescue ventilation devices. While we await results from large-scale prospective trials examining predictors of difficulty with use of these devices, problems might be anticipated in several situations. These include:

(a) inability to insert the device (e.g., restricted mouth opening);
(b) inability to properly position the device in the hypopharynx, (e.g., when cricoid pressure is applied or with airway pathology); and
(c) inability to maintain a seal or to ventilate (e.g., disrupted trachea, decreased lung compliance, or obstructing pathology either at, or below the cords).[5]

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Laryngeal mask airway

The **LMA** has emerged, during the past two decades, as one of the most important rescue ventilation and oxygenation devices in the management of a difficult and failed airway.[2] However, it is not without limitations. Although exceedingly rare, serious and fatal aspiration of gastric contents during LMA use has been reported.[9] The **ProSeal LMA** (PLMA; LMA North America, San Diego, CA, USA) was introduced in 2000, in part, to help address this issue. With the addition of a drainage tube running parallel to the airway tube and exiting at the mask tip, functional separation of the digestive and respiratory tracts is possible.[10] The drainage tube also provides a mechanism to help confirm correct mask tip location, while additional design features enable an improved seal and ventilation at higher airway pressures. In a comprehensive review on the PLMA, Cook *et al.* examine the clinical utility and limitations of the PLMA,[10] presenting the available evidence suggesting decreased (but not absent) risk of aspiration of gastric contents compared with the classic LMA. Aspiration risk increases with a malpositioned PLMA, which may in turn result from:

(a) a folded-over cuff;
(b) location of the drainage tube tip too proximal in the hypopharynx, i.e., above the cricoid ring; or
(c) location of the tip at, or in the glottic opening.[10]

Use of the 'gel' or 'soap' test can help identify malposition of the PLMA. To facilitate proper placement, an Eschmann Introducer (gum elastic bougie) can be placed into the esophagus under direct laryngoscopic vision with subsequent advancement of the PLMA over the Eschmann Introducer through the drainage tube.

New extraglottic devices

New extraglottic devices have been introduced in recent years, many of which may also play an important role in rescuing a failed airway. Several recent reports have detailed successful use of the **Laryngeal Tube™**,[11] the **CobraPLA**[12] (Engineered Medical System, Indianapolis, IN, USA) and the **PAxpress™**[13] (Vital Signs Inc., Totowa, NJ, USA) in providing effective ventilation and oxygenation in patients under a variety of difficult circumstances. Whether these devices will receive acceptance equal to that of the LMA and Combitube in the difficult airway is unknown.

While extraglottic devices have solidly established a role in ventilation and oxygenation, in many situations, they cannot replace a tracheal tube. Tracheal intubation through the classic LMA has been reported with some technical difficulties for many years. The **intubating (Fastrach)** LMA (ILMA; LMA North America, San Diego, CA, USA) was introduced to overcome the limitations of intubation through the classic LMA (e.g., small tube size). The effectiveness of blind tube passage through the ILMA has been studied by many investigators with somewhat contradictory results. Reported techniques to facilitate blind tracheal intubation through the ILMA include:

(a) seeking the position of optimal ventilation via the ILMA prior to tube passage; and
(b) applying a vertical lift on the mask (the 'Chandy maneuver') during the tube passage.

Successful use of adjunctive devices has also been described with the ILMA, including a lightwand,[14] and a fibreoptic bronchoscope.[15] Indeed, after reviewing the available evidence, the Difficult Airway Society in the United Kingdom recommends the use of the ILMA with a fibreoptic bronchoscope in their algorithm for managing the unanticipated difficult tracheal intubation in the non-obstetric adult patient with no upper airway obstruction.[3]

Rigid fibreoptic devices: video-laryngoscope and others

Specific anatomical characteristics make direct laryngoscopy impossible for some patients. The use of the new rigid fibreoptic or video-laryngoscopes may help to overcome this problem. Several studies have reported successful tracheal intubation using a new Canadian-developed **video-laryngoscope (GlideScope®**, Diagnostic Ultrasound Corporation, Bothell, WA, USA**)** in patients with a difficult or simulated difficult airway.[16–18] Doyle *et al.* described successful tracheal intubation using this device in a small series of awake patients with an anticipated difficult airway under topical anesthesia.[19] The technique was easy to use even in the presence of secretions or blood. Other rigid fibreoptic laryngoscopes, such as the **Bullard laryngoscope**[20] (Circon Corporation, Santa Barbara, CA, USA), **Shikani Seeing Optical Stylet**[21] (Clarus Medical LLC, Minneapolis, MN, USA), **StyletScope**[22] (Nihon Kohden Corp., Tokyo, Japan), **Angulated Video-Intubation Laryngoscope** (AVIL; Acutronic Medical Systems AG, Baar, Switzerland),[23] and the **Video-Optical Intubation Stylet**[24] (Acutronic Medical Systems AG, Baar, Switzerland) have been used successfully for tracheal intubation in patients presenting with difficult airway anatomy. More studies with larger patient populations are needed to help define the role of these devices in airway management.

Clinical impact of new airway technologies

With the development of these effective new intubation and ventilation devices, together with an improved understanding of the predictors of difficulty in all aspects (bag-mask, extraglottic device, intubation, and cricothyrotomy) of airway management, one would expect a change in the landscape of anesthesiology practice. However, in a 2002 survey of Canadian anesthesiologists, Jenkins *et al.* reported that direct laryngoscopy and fibreoptic bronchoscopy were still the preferred techniques for intubation when presented with a series of difficult airway patient scenarios, despite widespread availability of newer, and perhaps better airway equipment.[25] In a more recent review of anesthesiology practice in a large American teaching centre, these findings were echoed: the most commonly used alternative airway device for a failed laryngoscopic intubation was the flexible fibreoptic bronchoscope.[26] While fibreoptic intubation is an effective and safe technique of securing the airway, the presence of blood and secretions, together with significant set-up time may adversely limit its use in an emergency failed airway. Fortunately, signs are emerging that alternative airway techniques are being employed in different settings around the globe.[27,28] In fact, in the 2005 study reported by Burkle *et al.*, successful intubation was achieved using an **Eschmann Introducer** (Portex Limited, Hythe, UK) in 20.6% of patients and the ILMA in 11.6% of patients following a failed laryngoscopic intubation.[26] These are encouraging signs and we must continue to foster the use of these adjuncts and alternative technologies through academic training and continuing medical education programs.

With the cumulative evidence of successful alternative airway techniques, it is time to change our way of thinking. Devices such as the Trachlight™, the ILMA, flexible and rigid fibreoptic- and video-laryngoscopes, should no longer be looked upon as "rescue devices", but rather as effective primary techniques for use in difficult airway management. Many practitioners have effectively and safely mastered the use of the Trachlight™ [27,28] or other intubating devices[29] to the extent that they use these instruments as a first choice in a difficult situation. Thus, when a patient is identified in whom a skilled clinician anticipates a high likelihood of a failed direct laryngoscopy, the clinician should choose appropriate alternative devices or techniques as Plans "A", "B", and "C" to maximize the probability of successful intubation in a minimum number of attempts.[5,6]

In summary, we must continue to learn and teach others about the importance of a careful airway assessment which includes a comprehensive evaluation of the predictors of difficult ventilation using a mask or an extraglottic device, difficult intubation using direct laryngoscopy or alternative intubating devices, as well as a difficult surgical airway. We should also strive to improve our strategies and techniques in managing the difficult airway using the best available clinical resources and evidence.

Airway module objectives

1. To identify the importance of predicting the ease of ventilation as well as ease of laryngoscopy and tracheal intubation.
2. To state the uses and limitations of the LMA, and especially the PLMA.
3. To describe and compare new extraglottic airway devices, including the Laryngeal Tube™, the CobraPLA and the PAxpress.
4. To describe and compare newer intubating devices, such as the video-laryngoscope, the fibreoptic bronchoscope, the Trachlight, the Bullard laryngoscope, the Shikani Seeing Optical Stylet, the SyletScope, the AVIL, and the video-optical intubation stylet.

Instructions for completing the continuing medical education module

1. Read the highlighted references (*) below. Additional material on the topic may also be found in the non-highlighted references.
2. Log in at: www.cja-jca.org to answer the multiple-choice questions related to this module. Only individual subscribers will be able to log in.
3. Check the experts' explanation for the suggested correct answer.
4. After completing all the questions, compare your results with those participants who have already completed the module.

This program is accredited for ten hours (20 credits) under category 3 of the Royal College of Physicians and Surgeons of Canada CME program.

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