Airway management: "the times they are a-changin"

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Airway management has and will always be a priority in resuscitation efforts. The "ABCs" of resuscitation are in part an acronym of convenience meant to remind us to focus our management priorities. Traditionally, these priorities have included early endotracheal intubation and success was measured in part by completion of this procedure. Improved airway management patient outcomes depend on successful maintenance of physiologic parameters (oxygenation and hemodynamic status), not on placement of a polyvinyl endotracheal tube (ETT) alone. The prehospital world has served as a reminder that during resuscitation, we may have become too intubation focused, at the cost of the physiologic priority of oxygenation.[1–4] This evidence does not mean that direct laryngoscopy (DL) and intubation were a cause of harm but that physiologic goals must supersede tube placement as a desired end point. Before equating "A" with intubation, it is important to consider the following: Is it a "crash" situation, where airway control needs to be done immediately? Does the patient have difficult airway features? How experienced is the clinician poised to perform the procedure? Is help nearby? Answers to these key questions are more likely to positively influence outcome than any decision surrounding which airway device to use.

Since the introduction of the Macintosh laryngoscope in the 1940s, airway management has seen little change over time. Alternatives techniques to intubation such as the Bullard laryngoscope and the Lightwand (Trachlight) gained some "pocket" traction for the relatively few who were able to master skill in their use. The laryngeal mask airway (LMA) definitively changed the airway management landscape by providing a user-friendly rescue approach to failed oxygenation, a path that previously would have meant commitment to a surgical airway. More recently, an exponential rise in new airway equipment risks "device confusion," whereby a clinician may lack clarity on which device is most appropriate for the patient or scenario. The availability of new indirect technology, such as the videolaryngoscope (VL), has led some clinicians to suggest that the DL be relegated to a museum. This momentum away from DL and toward VL is likely unstoppable. Clinicians considering this change in practice need to do so with caution.

NEW TECHNOLOGY

In Canada, laryngoscopes are considered Class II medical devices and require manufacturers to "attest" that they possess evidence of safety and effectiveness. However this evidence most often represents non–peer-reviewed data and the market entry barriers are much less than those faced by the pharmaceutical industry. This creates significant potential for unopposed industry marketing influence as it often takes years before evidence emerges for or against the use of a particular airway device. The Difficult Airway Society in the United Kingdom has recognized this lack of regulation by creating the Airway Device Evaluation Project Team (ADEPT) to help provide a strategy for evaluating new airway technology.[5] There is no equivalent group in North America.

A classification for alternative intubation devices is presented in Table 1.[6]

There is significant heterogeneity in the device design of currently available alternative intubation products. Two examples of alternative intubation devices to break into the marketplace and around

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Table 1. Classification of alternatives to direct laryngoscopy

Alternative intubation devices
A. Blind devices (no visualization of airway)
1. Channel for ETT passage
• LMA Fastrach
2. Stylet
• Lightwand (e.g., Trachlight)
B. Indirect visualization: video-based devices
1. Videolaryngoscopes without built-in conduit for ETT
• Angled blades: GlideScope; McGrath Series 5; Storz C-MAC (D-blade); King Vision
• Macintosh blades: McGrath Mac; Storz C-MAC; GlideScope Direct; Venner A.P. Advance
2. Videolaryngoscopes with built-in conduit for ETT
• Pentax Airway Scope; Airtraq (with attached video system); King Vision; Venner A.P. Advance (difficult airway blade)
3. Video-based rigid/semirigid optical stylet
• Clarus Video System; Bonfils
4. Flexible videobronchoscopes; Ambu aScope
C. Indirect visualization: non–video-based devices
1. Bladed soft tissue control with built-in conduit for ETT
• Airtraq (mirrors/channel)
2. Bladed soft tissue control without built-in conduit for ETT
• Truview PCD (used without video camera)
3. Semirigid/rigid stylet
• Bonfils; Shikani; Levitan FPS
4. Flexible fibre-optic bronchoscopes

Adapted with permission from Law JA and Kovacs G.[6]
ETT = endotracheal tube; LMA = laryngeal mask airway.

which there is growing literature are the GlideScope and the Airtraq. These two very different devices are competing, along with many other devices, to establish a place as easier to learn alternatives to DL for management of both the normal and the difficult airway. The only common feature between these devices is that they are indirect systems that allow you to "see around the corner." Whether the device uses video, fibre-optic bundles, or mirrors matters less than blade angles, size, and the positioning of the distal visualization system (i.e., camera). VL has become the dominant indirect technology used in alternative intubation devices. One cannot assume that general comments or comparison of VL to DL can include all devices. Rather, comparisons need to be device specific as success or failure with one may not bring the same result with the other.

New technology is often expensive and afflicted with complicated components. There will be "out of service" time for such equipment. Despite improved durability and better pricing for alternative intubation devices, most emergency departments (EDs) cannot afford to have redundant VL systems. The dependable "tractor" in this industry remains a simple, well-engineered DL. When somebody yells, "Quick! Get the machine that goes 'ping'!" (Monty Python, *The* Meaning of Life) remember that it may not be available and you may be expected to use a crowbar instead (i.e., an available DL).

EXAMINING EVIDENCE

The literature evaluating VLs is growing. Support for VL as a primary approach in replacement of DL likely comes from data describing a favourable learning curve and positive results in difficult airway cases.[7–11] As consumers and clinicians, we must know, however, what questions to ask when evaluating a new device. The features of an ideal alternative intubation device are outlined in Table 2. The key research question relates to what incremental value a new device offers when compared to the current standard of care (e.g., DL with optimization manoeuvres such as head lift or external laryngeal manipulation and use of a commonly available adjunct such as the tracheal tube introducer [bougie]). Such studies should occur in both normal and difficult airway cases, using novice and experienced providers.[6]

Studies comparing VL to DL should ideally report first-attempt success rates, time to intubation, and the incidence of potentially significant adverse events (e.g., hypoxemia). Two meta-analyses of studies comparing VL to DL have demonstrated improved visualization without demonstrating more clinically relevant improved first-attempt success rates or shorter times

Table 2. Characteristics of an ideal alternative intubation device

Favourable learning curve/easy to use
Portable
Requires minimal manipulation to achieve a view
Has > 90% first-attempt success rate in the novice user in normal airways
Has > 90% first-attempt success rates after failed best look/tracheal tube introducer–assisted DL
Facilitates rapid intubation times (< 30 s)
Available in pediatric and adult sizing
Is a safe device
Cost effective

Adapted with permission from Law JA and Kovacs G.[6]
DL = direct laryngoscopy.

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to intubation.[12,13] A recently published prospective randomized trial comparing tracheal intubation using DL to VL in critically ill patients by novice providers reported no difference in the number of attempts for success and both an increased time to intubation and more frequent desaturations in the VL group.[14] When clinically relevant parameters are studied, the jury may still be out on the merits of VL when compared to optimal DL.

COMPETENCE

Beware of studies reporting very high success rates with a new intervention. In *Outliers*, Malcolm Gladwell challenges the commonly held perception of the "natural" who can achieve great success, apparently without effort.[15] Success without effort is usually luck, something we cannot depend on in acute care medicine. Most of us eventually realize that success is usually achieved only by experience and over time. If a published case series of intubation success was reported using a tongue depressor, most would not credit success to the device. The tool is only as good as the individual is in using it.

One of the greatest challenges facing emergency medicine is how to attain and maintain competence for relatively uncommon but potentially lifesaving procedures. For mostly uncontrollable reasons, even for high-volume EDs, getting a hands-on regular exposure to intubation is a challenge. ED data have reported higher success rates with VL when compared to DL.[16] However, a concerning statistic emerging from such studies is the low (e.g., 68%) first-attempt success rate with DL when compared to historical data.[16–18] These relatively poor results using DL could theoretically be due to an unintended dilution effect and an educational bias favouring VL use. The threat of losing a skill (DL) that remains the most common successful rescue approach following failed indirect intubation attempts is a serious concern.[19–21] Again, whether using a tongue depressor, a DL, or a VL, get good at it and stay good!

NEW CHALLENGES

Currently, there is no foolproof "automated external defibrillator–like" airway device. All airway devices require troubleshooting. Managing a patient with significant secretions, blood, and foreign material in the upper airway using an indirect device (i.e., a VL) may prove to be very difficult if not impossible. Otherwise, difficult videolaryngoscopy (glottic visualization) is relatively uncommon; rather, tracheal intubation, getting the ETT through the cords (glottic access) and/or down the trachea (subglottic advancement), is the more frequently encountered challenge.[7,22,23] Although channeled blade devices with a built-in conduit for ETTs were intended to help manage these issues, ETT access and advancement challenges continue to be described.[7,22,23] In part as a result of a minimally required market entry scrutiny, problem-solving skills are acquired with in vivo experience, with the potential unintended consequences of device-related adverse events. Many of these challenges are again device specific, and problem-solving manoeuvres may not always be transferable from one product to another.[7,22] There are currently no validated predictive models that help the clinician decide which of these new devices will add value to a given clinical scenario.

PREDICTING THE FUTURE

There are numerous examples over time where a new technology has superseded an older one. Other than niche markets, vinyl records and cassettes have essentially disappeared as a medium for music. Is this the path for DL? This is unlikely, and the more predictable path is one that parallels television and radio. Both use technology to tell a story, and despite frequent, almost annual, television hardware upgrades, the radio, essentially unchanged, remains a reliable and relevant medium for story telling.

Safe and effective emergency airway management requires an array of cognitive and procedural skills. These skills have evolved over time from our early days of nasotracheal intubation. Just as rapid sequence intubation is more than "pushing drugs," device choice is not as simple as DL versus VL. I am confident that VL will establish an evidence-based place in this complex environment of emergency airway management. VL, however, is not a "magic bullet"; it is a device option, and when used by the right person, in the right situation, on the right patient, it may be of value.

I am frequently asked what airway equipment I would want in a remote ED setting. For any patient in whom I am anticipating the need for advanced airway management, I would want access to nasal prongs

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connected to high-flow oxygen, a bag valve mask with a positive end-expiratory pressure (PEEP) valve, a rechargeable high-quality Macintosh laryngoscope, a tracheal tube introducer (a.k.a. bougie), various sizes of LMAs, ETTs, a number 10 scalpel, and an alternative indirect device that meets most of the criteria outlined in Table 2 when used in my hands. We all need to decide what works best for each of us and what provides the best results for our patients.

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