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Is Direct Laryngoscopy Obsolete?

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Statements

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Interestingly, the father of laryngology, Manuel Garcia (1805 to 1906) was neither an anesthesiologist nor an otolaryngologist (3). He was an opera instructor intrigued by the larynx, a seemingly simple organ capable of producing a rich range of sounds. Not only

are these short bands of tissue occasionally able to produce extraordinarily beautiful music, they are the principal means by which we communicate. Many people including teachers, religious leaders, entertainers, and alas politicians and lawyers depend upon the larynx for their livelihood. Even minor laryngeal injuries to them can result in significant disability. The vocal cords are even more densely innervated than the muscles responsible for facial expression (25). Moods and attitudes are conveyed through extraordinarily subtle alterations in voice as evidenced by our ability to communicate with infants and domesticated animals even when our words have no meaning.

The larynx is a deceptively complex instrument that we can better understand using stroboscopic instruments that allow synchronization of light and vocal fold frequencies. Slight variations in vocal fold tension produce sound when tracheal air, under pressure, is presented to them. To produce quality and variable sound, their mucosal surfaces, particularly their edges, should be smooth, pliable, elastic, capable of close apposition, and very precise adjustments of tension. These folds produce the sound; the pharynx, oral cavity, and nose serve as a resonating chamber. As laryngoscopists, it is important for us to make every effort to perform our tasks with the greatest of respect for so sensitive and vital a structure.

Yet consider how we achieve our airway objectives? We open the mouth widely, extend the neck, insert cold steel between the teeth, and apply upward force (distracting and compressing the tongue, elevating the mandible, applying tension to the delicate tonsillar pillars, engaging the vallecula or epiglottis, and hoisting it skyward) in an effort to visualize a structure that is concealed for its own protection. Each one of these maneuvers is capable of resulting in injury and each may fail to achieve its objective. If we are only partially successful, we may introduce a tracheal tube (TT) without having completely visualized the target.

Prior to the introduction of the standard laryngeal mask airway (the Laryngeal Mask Airway Classic, manufactured by the Laryngeal Mask Company, Henley on Thames, United Kingdom), airway management had not changed very much since Janeway performed tracheal cannulation in 1913. We have continued to use the same crude line-of-sight laryngoscopes Miller and Macintosh communicated in 1941 and 1943, respectively. These devices are inexpensive, pervasive, and difficult to learn; to some extent, this expertise helps to define our specialty. Yet we know that even in the best of hands, there are patients with anatomical characteristics that do not favor successful visualization of laryngeal structures. Furthermore, we know that there is an irreducible number of patients, perhaps 8.5 percent (21), in whom direct laryngoscopy (DL) unexpectedly fails. So far, our attempts at finding an intubating position that achieves alignment of the "anatomical axes" has yielded the flexion/extension (sniffing), neutral, simple extension, and flexion/flexion positions (13, 16). It would appear that we have exhausted the combinations but have yet to find a position that achieves the objective.

To date, our focus has been on catastrophes and serious injuries associated with tracheal intubation (1, 8, 10). These include failed or delayed tracheal intubations that may result in esophageal injuries, mediastinitis, persistent or profound hypoxia, aspiration, brain injury, and death. We have also looked at cervical, dental, laryngeal, and tracheal injuries. Furthermore, we know that multiple attempts at DL and tracheal intubation are associated with hypoxemia, hypercapnia, hypertension, unanticipated admission to the

intensive care unit, and injuries to the teeth, trachea, and esophagus (9). They may also be associated with cardiac arrest and death (20).

There is an increasing number of alternatives to tracheal intubation (represented by a vast array of supraglottic/extraglottic airway devices). Likewise, there are numerous ways of tracheal intubation not requiring DL. Some of these are blind techniques [for example, the digital, blind nasal, or lightwand-assisted technique and blind tracheal intubation through the intubating laryngeal mask airway (the Laryngeal Mask Airway Fastrach, manufactured by the Laryngeal Mask Company)] and some of these are visual [for example, flexible bronchoscopy-assisted (FBA) tracheal intubation using a laryngeal mask airway as conduit]. Up to now, our gold standard for managing the anticipated difficult airway has been FBA tracheal intubation, and in skilled hands, this remains the best, and occasionally the only likely successful approach. Flexible bronchoscopes (FBs) were designed for versatility, not specifically for tracheal intubation. They can be used to place endobronchial tubes and blockers, to look through tracheostomies, and to perform diagnostic/therapeutic procedures like bronchoalveolar lavage and biopsies. Their complexity also makes them expensive, complex, and fragile.

But let's look at another aspect of FBA tracheal intubation. Assuming that we are able to direct the FB into the trachea, it is not uncommon to encounter difficulty advancing the TT over the FB. In fact, in the awake, spontaneously breathing patient, this is often the most challenging and for the patient, the most irritating part of tracheal intubation. Johnson and co-workers (17) demonstrated that in 48 awake adults with either known difficult airways or cervical spine injuries, the TT impinged upon the right arytenoid (in 42 percent) or the interarytenoid soft tissues (in 11 percent), often requiring multiple attempts with TT rotation. Others have reported an even higher incidence (40 to 90 percent) of such difficulties (17). FBA tracheal intubation involves visually-directed placement of the FB; thereafter, the FB functions much like a flexible introducer. Maktabi and co-workers (12) described three patients who underwent FBA tracheal intubation and suffered injuries including vocal cord bruising, extensive supraglottic swelling, and a very large pharyngeal hematoma. Clearly, such injuries are better than hypoxia, brain injury, or death, but perhaps such injuries can be reduced if we can achieve visualization of the laryngeal aperture, even in those challenging patients, observing TT placement and advancement. Perhaps, newer purpose-specific fiberoptic stylets and laryngoscopes or video laryngoscopes will enable us to accomplish this.

The recent analysis of the American Society of Anesthesiologists Closed Claims Project database found that only 17 of 87 tracheal intubation-associated laryngeal injuries were associated with "difficult intubations" (10). Other studies led to the conclusion that most laryngeal injuries are unrelated to the duration of tracheal intubation. Either we do not know what "difficult intubation" means or tracheal intubation, as conventionally performed is problematic (18). Studying 80 adults with normal airways, Mencke and co-workers (19) randomized them to tracheal intubation with or without a neuromuscular blocker. They found that neuromuscular blockade was associated with better intubating conditions, a lower incidence of sore throat, and fewer "vocal cord sequelae" (hematoma, mucosal thickening, and granuloma, as determined by video laryngostroboscopy). Such complications were more common among patients in whom intubating conditions were less favorable. Postoperative hoarseness can be quite persistent but rarely comes to our attention. When either severe or persistent, it can be quite disruptive to our patients.

Laryngeal edema may be a consequence of placing a round TT through a triangular opening. This is consistent with the observation of Tanaka and co-workers (23) who measured laryngeal resistance before and after anesthesia administered via either a TT or a standard laryngeal mask airway, and also performed endoscopic comparisons of the vocal cords of the two groups. They found higher laryngeal resistance and evidence of vocal cord swelling in the patients who had been tracheally intubated, though none of these tracheal intubations had been difficult.

If we regard postoperative hoarseness or “vocal cord sequelae” as complications of airway management, it provides incentive for us to refine our techniques. Is it not incumbent upon us to identify the causes of such injuries and to strive to reduce or eliminate these complications? Should the lack of postoperative hoarseness become a new quality indicator?

As discussed above, FBA tracheal intubation essentially involves the blind manipulation and advancement of the TT over a flexible introducer. We are usually rewarded by our success and expect the patient to be grateful for our talents despite the discomfort they may experience. While laryngeal injury has been reported, it appears to be rare; but could this be because we have not looked for it? It seems logical that visualized placement and advancement of the TT is likely to result in less laryngeal injury. DL has been our standard method of achieving this. Unfortunately, we must acknowledge that even in the best of hands, DL fails to reveal the laryngeal aperture in a significant number of cases. Furthermore, we are not particularly good at predicting the patients in whom DL is likely to fail. It is time to correct our terminology; laryngoscopy that does not reveal the laryngeal aperture is not difficult laryngoscopy, it is failed laryngoscopy (4). Our airway assessment tools have been calibrated specifically for DL; and faulty though they are for DL, they likely have limited relevance to techniques other than DL.

In their classic paper, Cormack and Lehane (7) recommended the use of the “Oxford introducer” in situations when the epiglottis, but not the laryngeal aperture could be seen. This device is now generally known as the “gum elastic bougie” (GEB; the Eschmann Introducer, manufactured by Smiths Medical, Watford, United Kingdom). In fact, they estimated that such a view occurs in 1 of 2000 obstetrical airways, a figure that seems to be much lower than in other studies. Combes and co-workers (2) prospectively evaluated a strategy that employed the GEB after two unsuccessful attempts at tracheal intubation by DL. One hundred out of 11,257 (0.9 percent) adult patients, unexpectedly could not be intubated and a GEB was used in 89 patients. This was successful in 90 percent (80/89 patients) but required two or more (blind) attempts in half of these cases. Undoubtedly, this low-tech approach is partly responsible for the popularity of this technique, but we have to question whether a blind 90- percent solution (“successful” on the first attempt in only 41 percent of the patients) is an admirable strategy?

Rigid fiberoptic laryngoscopes [for example, the Bullard laryngoscope (Gyros ACMI, Reading, United Kingdom), the UpsherScope Ultra laryngoscope (Mercury Medical, Clearwater, Florida, United States), or the WuScope System (Achi Corporation, San Jose, California, United States)] have been on the market for about two decades. They have their champions, able to demonstrate the utility of these devices in the management of many patients with difficult airways (5, 15). None is dependent upon a

line-of-sight and all provide high quality laryngeal exposure with very limited tissue distraction or compression. Each device is compatible with standard video equipment enabling the display and/or recording of the laryngoscopy and tracheal intubation process. Furthermore, each device positions the eye of the operator, centimeters proximal to the larynx offering a view of TT placement and advancement through the laryngeal aperture. They were developed specifically for laryngoscopy and tracheal intubation and lack the versatility of the FB. The fiberoptic channels are protected within a rigid scope and are therefore resistant to damage. Compared with FBs, the acquisition and maintenance costs are low. Why then, do they enjoy such limited popularity (22, 24)? Despite their utility, they have significant learning curves - though probably less than that required for either with conventional laryngoscopes or FBs - but lack a sufficient cadre of committed enthusiasts. Unfortunately, even the manufacturers and distributors lack the commitment to support these products.

Several promising devices have recently become available, including though not limited to the TrueView EVO2 laryngoscope (Truphatek, Netanya, Israel), the DCI Video Intubation System (Karl Storz Endoscopy, Tuttlingen, Germany), the GlideScope Video Laryngoscope (GVL; manufactured by Verathon Medical, Bothell, Washington, United States), the McGrath Portable Video Laryngoscope (MVL; manufactured by Aircraft Medical, Edinburgh, United Kingdom), and the Airtraq Optical Laryngoscope (Prodol Meditec, Vizcaya, Spain) (5). These devices make use of prisms, telescopes, or charge coupled device (CCD) technology to look around the anatomical corners: the TruView EVO2 laryngoscope employs an inexpensive telescope angled at approximately 45 degrees; the DCI Video Intubation System uses a fiberoptic bundle coupled to an internal video camera, directed approximately 25 degrees from the line-of-sight; the GVL consists of embedded light emitting diodes (LEDs) to provide a light source and a non-fogging CCD aligned at 60 degrees from the line-of-sight; the MVL has a sliding disposable blade (one size fits for all) and a small liquid crystal display screen attached to the handle; the Airtraq Optical Laryngoscope is a prism-based disposable device with a LED light source, a non-fogging optical system, and a tube-guide channel for the TT.

These devices are all relatively easy to use. Some have been more thoroughly investigated than others, with manikins and normal and challenging airways. A comprehensive review of these devices is beyond the scope of this presentation. At the risk of seeming biased - and bearing in mind, the disclosure of the author of this special comment - the GVL has been the most thoroughly tested. An early multi-centered study among largely anesthesiologists with limited experience with the GVL yielded 99 percent Cormack-Lehane 1 or 2 views and a 96.4 percent success of tracheal intubation (6). More recent studies involving anesthesiologists with formal GVL training, yielded laryngeal views that were always equal to or better than obtained by DL. An example of this is a recent study reported from Vienna: Krasser and co-workers (14) performed both DL and GVL on 442 patients; all tracheal intubations were successful (after a maximum of two attempts), in 437 patients on the first attempt. The study had a bias for enrolling patients with challenging airways; laryngeal exposure was achieved using the GVL in every patient despite not being able to accomplish this in 24 percent (105/442 patients) using direct laryngoscopy.

Another exciting approach involves the co-application of more than one device to achieve tracheal intubation. The recently introduced Laryngeal Mask Airway C-Trach (Laryngeal Mask Company) and the intubating laryngeal mask airway [in combination

with a lightwand (12) or FB] are examples of this. Doyle (11) has described the GVL to facilitate instruction of FBA tracheal intubation since it enables the mentor to see precisely where the FB is placed (11). Used thusly, the GVL also provides tongue retraction, directs the placement of the FB and most importantly, enables the operator to observe the insertion and advancement of the TT through the laryngeal aperture. Levitan (emergency medicine physician, Philadelphia, Pennsylvania, United States) has recently modified the Shikani Optical Stylet (Clarus Medical, Minneapolis, Minnesota, United States), and proposes that the Levitan FPS Scope (Clarus Medical) be used in conjunction with a conventional laryngoscope, GVL, MVL, or other such device. Laryngoscopy is performed using a laryngoscope and a TT, loaded onto the scope stylet, is introduced under the epiglottis. The operator then diverts his attention from the laryngoscope to the eyepiece of the scope stylet, observing the insertion and advancement of the TT.

DL is a legacy technique; it was introduced at a time when there were no alternatives. We now have a wealth of supraglottic airway devices and are able to safely avoid tracheal intubation in a significant number of patients. But when tracheal intubation is deemed appropriate, fiberoptic and video technology can generally provide a laryngeal view, even in patients in whom this was previously presumed to be difficult or impossible. Our current airway assessment is predicated on DL. An anticipated difficult DL does not mean that laryngoscopy will be difficult if DL is not employed.

To summarize the advantages of these new techniques over DL:

- The high upfront cost may be offset by predictable operating costs. Compared with FBs, they are robust and more resistant to damage.
- Fiberoptic and video laryngoscopes produce a higher proportion of successful laryngeal visualizations than DL. Laryngoscopy that fails to reveal the larynx is failed laryngoscopy.
- Tracheal intubation that succeeds despite failed visualization is a near miss.
- When DL fails, we try harder. More forceful elevation and multiple attempts are associated with greater morbidity and mortality.
- Many of the newer techniques are easy to learn and can be easily introduced into our practice. This is more applicable to video laryngoscopy than rigid fiberoptic laryngoscopy.
- Ideally, the technique should be suitable in challenging settings (blood, secretions, rapid-sequence induction, poor oxygenation, awake patient) and resistant to fogging.
- Old airway management was about getting the TT in. New airway management is about achieving this with minimal discomfort and postoperative laryngeal morbidity.
- We should not reserve the best methods for only our most difficult patients; they should be offered to all our patients. This will provide our patients with the best care. It will ensure that we gain experience with the techniques we select and an appreciation of their limitations and value.

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