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Review Article

Videolaryngoscopy in Airway Management: What Every Anesthesiologist Should Know!

Fu-Shan Xue, Ya-Yang Liu, Hui-Xian Li, and Gui-Zhen Yang

ABSTRACT

Aim of review: The aim of this article is to convey several hotspot issues regarding the use of videolaryngoscopy (VL) in airway management that anesthesiologists are often concerned.

Methods: Recent literature in the past 20 years about the use of VL in the clinical airway management were searched from the Pubmed and Cochrane databases and reviewed, in order to determine the strengths and weakness of VL and conflicting issues regarding the role of VL in airway management.

Recent findings: The benefits of VL are most significant in patients with difficult airways, with an improved laryngeal view and an increased success rate of intubation. However, VL cannot give a 100% success rate and there is no specific evaluation system of difficult or failed VL as with direct laryngoscopy. Awake VL-assisted intubation is a useful alternative to awake fiberoptic intubation, but the fiberoptic bronchoscope cannot be discarded and still is gold standard tool of difficult airway management. There are several different-type VLs available and their efficacies may be different between devices due to various designs and shapes. Due to the limited number of comparative studies, however, there is inconclusive evidence to recommend which VL design is more advantageous in various clinical situations. A Macintosh-type VL allows residents to learn laryngoscopy and intubation more quickly and effectively. Given that VL has tremendous advantages, it should be used as the first-line device for all tracheal intubations.

Summary: The introduction of VL has resulted in a dramatic transformation of clinical airway management and is seen as the evolutionary step in intubation technology. There are considerable disagreements over the role of VL in airway management and the need of more investigation, but VL continues to get popularity both inside and outside the operating room. With increasing use of VL in airway management, experience and skill will undoubtedly increase, and the evidence will suggest that the attempt numbers and complications of intubations may be decreased, and patient safety can be improved. (Funded by the Major Project of Zhejiang Science and Technology Fund.)

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Securing a patent airway with tracheal intubation in patients undergoing general anesthesia, a core work of all anesthesiologists, is routinely performed using direct laryngoscopy (DL). As DL is a complicated skill with a variable learning curve, training, experience and regular practice are required to acquire and maintain this skill (1). Most importantly, DL requires a direct line of sight to align oral-pharyngeal-laryngeal axes for optimal visualization of the larynx, which is often a prerequisite for successful intubation. Thus, there are numerous difficulties associated with intubation using DL, i.e., difficult laryngoscopy, difficult intubation and failed intubation, which have important effects on patient morbidity or mortality (2, 3). Furthermore, manipulations used to align the three airway axes, such as head extension, neck flexion and external laryngeal pressure, may lead to adverse outcomes, such as significant hemodynamic disturbance, cervical instability and upper airway injury (4).

In contrast to DL, videolaryngoscopy (VL) adopts a camera positioned near the tip of the blade to obtain the indirect visualization of the larynx. This is why VL is also called as indirect laryngoscopy. The resulting change in the visual vantage point from the outside oral cavity to behind the tongue within the hypopharynx has obviated the need to create a direct line of sight, and it has instead allowed the ability to "see around the corners" of the upper airway (Figure 1). Thus, VL can obtain a good visualization of the larynx without the need to align the three airway axes (1). In fact, the angle of vision and the direction of vision are completely different between VL and DL. As compared to DL, VL does not create a better exposure of anatomy but it makes possible to obtain a better view of the same anatomic structures (Figure 2) (5). There are considerable disagreements over the role of VL in airway management and the need of more investigation, but VL continues to get popularity both inside and outside the operating room. This article is aimed to convey several hotspot issues regarding the use of VL in airway management that anesthesiologists are often concerned.

What is Efficacy of Videolaryngoscopy?

It is generally believed that VL should be at least as safe as and more effective than the DL to justify the expense of acquisition and the requirement that anesthesiologists become proficient with them. The main benefit of VL is that the laryngeal view is projected onto a video monitor from a camera attached to the anterior part of the blade. This eliminates the need to displace the soft tissues of the upper airway and change the position of patient' s head and neck for the alignment of three airway axes, and allows the operator to obtain the laryngeal visualization by "seeing around the corners" of the upper airway (1). The available literature shows that the laryngeal visualization is better with VL compared to DL, especially for angulated VLs (6, 7).

The angulated VLs may be advantageous in patients with difficult airways, but a good laryngeal visualization does not always translate into a high intubation success rate. Lafferty et al. (8) reported that when using VL, gaining a laryngeal view only was the easy part and difficulty with tracheal tube passage may occur. This means that VL may provide an excellent laryngeal visualization, but indirect passage of the tracheal tube represents a paradigm shift that requires education and practice. When tracheal intubation is performed using VL, moreover, a challenge for the operator is to become familiar with the airway view on the monitor and to coordinate the eyes and hands appropriately.

The available evidence shows that VL does not seem to offer anything more than DL in patients with easy airways; the intubation success rate is approximately the same with DL, while the intubation time is prolonged with VL (6, 7). The benefits of VL are most significant in patients with difficult airways, as it converts "blind" intubations into intubations under visual control (9). In patients with difficult airways, VL can provide a higher intubation success rate and a shorter intubation time than DL (10-12).

When is Videolaryngoscopy Most Valuable?

When you are managing a difficult airway, it is never a bad idea to have a VL within reach. There are many clinical reports and randomized controlled trials (RCTs) having validated the value of VL in patients with difficult airways, in whom tracheal intubation with a DL is predicted as difficult or has failed. In a case series including 270 adult patients in whom DL had been difficult and in 23 patients with predicted difficult intubation, tracheal intubation with the Pentax-Airwayscope VL was successful in 290 of 293 patients (13). Cavus et al. (14) evaluated the salvage effectiveness of the Storz C-MAC D-blade VL in 20 patients after failed intubation with the DL; in all patients, the laryngeal view was improved with the VL and intubation was successful in an average of 17 s.

In a retrospective study including 2,004 patients, Aziz et al. (15) demonstrated a 97% success rate of intubation using the Glidescope VL following failed DL. When two intubation attempts by senior anesthesiologists with a Macintosh DL had failed, Malin et al. (16) showed that subsequent intubation was achieved with the Airtraq laryngoscope in 36 of 47 patients (80%). After failure of Macintosh DL in 61 patients with a Cormack and Lehane grade 3 or 4 laryngeal view, Noppens et al. (17) assessed the performance of McGrath Series 5 VL as a rescue device and showed that this device improved laryngeal visualization and enabled tracheal intubation in 95% of cases.

More important, a recent retrospective study by Aziz et al. (18) evaluating the use of five rescue devices after failed intubation with a DL in 1,427 patients demonstrated that a VL was most frequently chosen rescue device and was associated with a significantly higher success rate (92%) than other devices including a supraglottic airway device (78%), a fiberoptic bronchoscope (FOB) (78%), a lighted stylet (77%), and an optical stylet (67%). Given that each repeated DL attempt is associated with a decreased probability of success and each subsequent attempt significantly increases the chance of patient injury (2, 3), it seems reasonable for the use of VL as the first choice to rescue the airway at an early stage of failed DL.

In available literature, there have been several RCTs comparing performances of different VLs with a Macintosh DL in adult patients with predicted difficult airway. These studies unanimously show an improved laryngeal visualization and a higher intubation success rate with the VL (19-23). Thus, it is clear that VL can offer mostly significant benefit for difficult airway management. Furthermore, current algorithms for difficult airway management have recommended VL as rescue tool for difficult or failed DL (24-26).

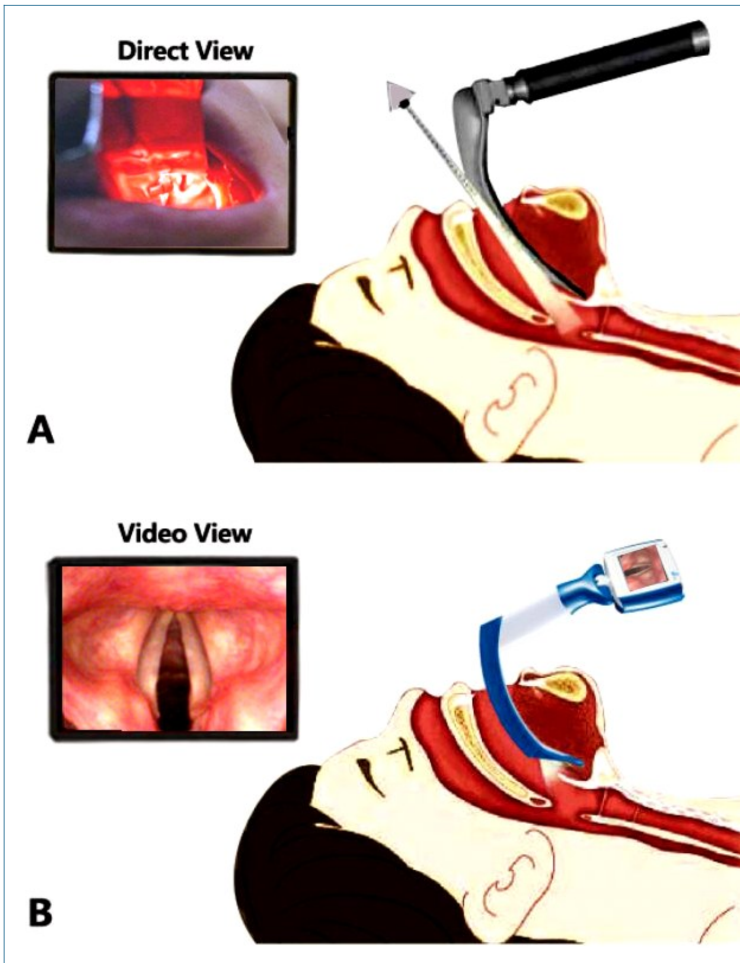

Figure 1. The Visual Vantage Points of Direct and Video Laryngoscopy.
A. Direct laryngoscopy provides a direct line of sight and limits the visual field within the hypopharynx. B. With videolaryngoscopy, a visual vantage point at the tip of the blade offers an improved laryngeal view.

What is Failure Rate of Videolaryngoscopy?

The anesthesiologists must bear in mind that no single device can address all clinical issues and no single technique is better than others in all situations, because each device has unique properties that may be advantageous in certain situations, but limiting in others (8, 27). The VL may

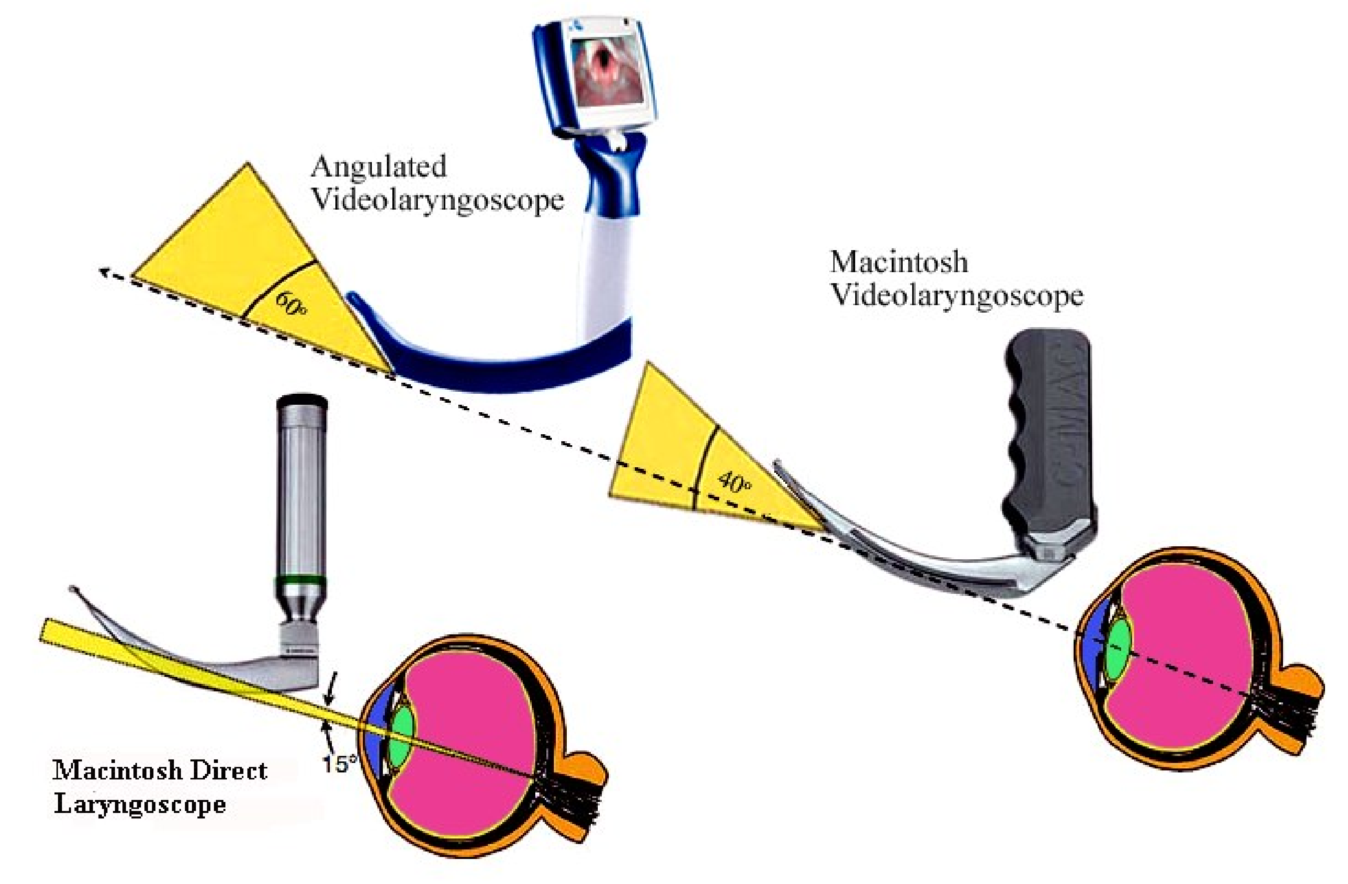

Figure 2. Vertical Angles of View with Macintosh-Type and Angulated Videolaryngoscopes Compared with a Macintosh Direct Laryngoscope.

provide a high intubation success rate in patients with difficult airways, but cannot give a 100% success rate. Aziz et al. (15) described the two-centre experience of using GlideScope VL and showed that this device had a 3% failure rate when used in patients with anticipated difficult airways and a 6% failure rate when used to rescue failed DL. That is, the GlideScope VL fails once every 33 patients with difficult airways and once every 16 patients with failed DL. Even in recent study by Aziz et al. (18), tracheal intubation with VL was unsuccessful in 10% of patients with a failed DL. In another recent large multicentre study including 1,100 patients with predicted difficult airways, Aziz et al. (28) showed that intubation failure rate at first attempt was 4% with the GlideScope VL and 7% with the Storz C-MAC D-blade VL, respectively. In a methodologically excellent multicentre randomized controlled study comparing performance of 6 VLs including 3 unchannelled (Storz C-MAC D-blade, GlideScope and McGrath Series 5) and 3 channelled (Airtraq laryngoscope, A.P. Advance difficult airway blade VL, and KingVision VL) devices in 720 patients with a simulated difficult airway by application of a cervical collar, Kleine-Brueggeney et al. (27) found that the total failure rates of VLs were 2%-63%, with a highest failure when using the A.P. Advance difficult airway blade VL.

The common causes of failed VL include a limited mouth opening, a reduced neck movement, a large tongue, a tumor in the oropharynx, technical failures or blurred vision by fogging, secretions, blood, or vomitus, cricoid pressure, etc (1, 15, 17, 19, 27). Despite VL is relative ease of use, moreover, a learning curve still exists, and poor technique may result in failed intubation, multiple attempts and airway injury. It is generally believed that experience and competence with VLs are critical for their successful use in clinical setting.

With the availability of VL, we would like to remind that anesthesiologists do not let themselves to become complacent with safe airway management practices. Given that VL does fail, it is unlikely to be a panacea for management of all difficult airway situations and any difficult airway management strategy including VL must include a contingency plan for failure. Most importantly, moreover, only overriding goal in airway management is patient oxygenation, which should remain the key point in any device-based strategy. Thus, when managing difficult airway, safety is about redundancy; there are at least two ways to oxygenate (facemask, laryngeal mask airway, etc) and 2 ways to intubate (a VL or other imaging device) (2).

Can Difficult or Failed Videolaryngoscopy Be Predicted?

It is clear that VL is not useful if mouth opening is very limited, as an inter-dental distance of at least 18 to 20 mm is required to insert even the narrow blades. The large upper airway or pharyngeal space-occupying lesions may also preclude the use of VL (1). A large retrospective study by Aziz et al. (15) in patients with predicted difficult airways showed that the strongest predictors of failed VL were distorted anatomy by previous surgery, local mass and scarring following radiotherapy. This suggested that VL may not make intubation easier in severe upper airway distortion caused by malignancy or extensive oropharyngeal infection.

In a secondary analysis of a data set gathered from a multicentre prospective RCT by Aziz et al. (29) comparing GlideScope and Storz C-MAC D-blade VLs in 1,100 patients with anticipated difficult DL, 301 were identified as difficult VL. The multivariate logistic regression analysis showed that four predictors of difficult VL were supine sniffing position, limited mouth opening, planned otolaryngologic or cardiac surgery, and intubation by an attending anesthesiologist. The authors concluded that amongst these factors, avoiding the supine sniffing position and altering providers when attempting angulated VLs could easily be implemented in routine clinical practice.

In a prospective study identifying patient characteristics associated with difficult intubation with GlideScope VL, Tremblay et al. (30) demonstrated that intubation was likely to be more challenging in patients with high Cormack and Lehane grades of laryngeal view using DL, high upper lip bite test score, or short sternothyroid distance. In this single-center study, presence of blood in the airway, airway edema, cervical immobility, and obesity were associated with higher odds of first-attempt failure, when intubation was performed with VL in an ICU (31).

It must be emphasized that current airway assessment is predicated on difficult DL, but an anticipated difficult DL does not mean that VL will be difficult and vice versa (13-18). In the available literature, there was no specific evaluation system of difficult or failed VL as with DL. Furthermore, the reasons of difficult or failed intubations with VL and DL may be different due to numerous differences between them in the laryngeal visualization, tube delivery to the glottis and tube advancement into the trachea. It has been shown that standard clinical risk factors of difficult DL were not effective predictors of VL failure at first attempt (32).

The Cormack-Lehane grade and its modifications are originally designed to evaluate the laryngeal visualization with DL, which requires the alignment of the three airway axes (33). Because VL does not need to align the airway axes, these classification systems cannot be used to evaluate performance of VL, especially for angulated and channeled VLs (1). In fact, it is also not logical to compare the views seen by our eyes from the outside oral cavity with those obtained from a camera placed in the oropharyngeal space near the tip of the blade, even if the same instrument is used in both cases (5). A poor laryngeal view has been validated as an effective variable for difficult or failed intubation with DL, but it is not true for VL. What usually determines the successful intubation with VL is the alignment of the device and subsequent trajectory of the tracheal tube into the glottis as it is delivered (9).

Is Awake Videolaryngoscopy- Assisted Intubation a Useful Alternative to Awake Fiberoptic Intubation?

In the 1960s the FOB was established as the gold standard device for difficult airway management because of its ability to be manually manipulated and see around corners. Furthermore, securing the airway using awake fiberoptic intubation has been regarded as the safest method of airway management in the patients with known difficult airways (34). However, most anesthesiologists agree that fiberoptic intubation is a challenging skill to learn and master. In order to achieve the competence with fiberoptic intubation (> 90% success rate within 3 minutes), anesthesiologists need to perform at least 25 intubations (35). Once learned, moreover, regular practice is still required to maintain this skill.

There are several differently designed video and optical devices that claim superiority, and hope to be crowned as the gold standard tools for difficult airway management. Of them, awake VL- assisted intubation is a novel option that is drawing more and more attention as an alternative to awake fiberoptic intubation. Hitherto, there are several randomized controlled clinical trials having compared awake intubations using VL and FOB in patients with predicted and known difficult airways. All of these studies showed that as with awake fiberoptic intubation, awake VL- assisted intubation achieved a high success rate, satisfactory intubation times, and a high acceptance of patients and anesthesiologists. Thus, it is concluded that in patients with predicted and known difficult intubations, awake VL- assisted intubation represents an acceptable alternative to awake fibreoptic intubation (36-40).

As compared to awake fiberoptic intubation, the potential advantages of awake VL-guided intubation include (41- 44): (a) VL can create space within the upper airway, allowing effective aspiration of secretions and blood from the airway, and facilitating airway topical anesthesia under direct vision; (b) In contrast to blind passage of the tracheal tube via the FOB, the tracheal tube placement can be observed with VL, reducing the risks of the tube impingement at the glottis and airway trauma; (c) The magnified airway views provided by VL help recognition of airway landmarks in the presence of distorted anatomy; (d) During awake VL- guided intubation, advancing the tracheal tube was often associated with relief of the airway obstruction, making it easier for the patient to breathe; (e) Preoperative airway assessment can be performed with VL in awake patients, in order to assess the need for awake intubation.

Like all airway management techniques, however, awake VL-guided intubation alone is not going to be suitable for all patients with known difficult airways. For instance, this technique may not be appropriate for patients with limited mouth opening. Moreover, there are many pathologic conditions that will predictably prevent success with VL and thereby contraindicate its use (15, 18, 19, 27). These issues may explain why the introduction of VL cannot decrease the use of awake fiberoptic intubation for difficult airway management (45, 46). Thus, we cannot discard the FOB as it will still be needed in patients with uniquely altered airway anatomy. As shown by the Law et al. (47), awake fiberoptic intubation could be performed with a high success rate and a very low complication rate in very large numbers of patients over a long period of time. Furthermore, awake intubation by combined VL and FOB has been used in most difficult airway conditions (42, 48- 50) and shown further improvement on the success rate in patients with anticipated difficult airways (51). Other than FOB, the available evidence also supported usefulness of combined VL and other devices including tube introducer, Bonfils intubation fiberscope and Boedeker intubation forceps in difficult airway conditions (52-54).

Different Videolaryngoscopes, Different Efficacies

Currently, there are several different- type VLs available and their efficacies may be different between devices due to various designs and shapes. To facilitate the suitable choice of these devices for various airway conditions, efficacy and safety of each VL should be compared with those of other VLs and intubation devices (e.g., a FOB) (1). The large RCTs comparing various intubation devices or strategies would be necessary, but they are neither easy to design nor easy to carry out because of the relative rarity of difficult airways. Thus, many VLs that have not and may never be subjected to rigorous clinical trials have already been purchased commercially and are being used in clinical practice with little evidence of their performance.

In a multicentre, prospective RCT, Kleine-Brueggeney et al. (27) evaluated six VLs in patients with a simulated difficult airway and showed that first-attempt success rates were 98% with McGrath Series 5 VL, 95% with Storz C-MAC D-blade VL, 87% with KingVision VL, 85% with GlideScope VL and Airtraq laryngoscope, and 37% with the A.P. Advance difficult airway blade VL, respectively. Furthermore, McGrath Series 5 VL with modestly curved blade performed best and was the only device with a 95% confidence interval for success rate >90%. Another multicentre, prospective RCT by Kleine-Brueggeney et al. (55) comparing three unchannelled VLs in patients with a simulated difficult airway demonstrated that the first-attempt success rates were 90% with KingVision VL, 82% with Airtraq laryngoscope, and 49% with the A.P. Advance MAC VL, respectively. The findings of Kleine-Brueggeney et al. at least indicated that A.P. Advance VL performed poorly in the airway with limited mouth opening and reduced neck movement created by using a hard neck collar. Furthermore, performance was better with the KingVision VL and Airtraq laryngoscope than the A.P. Advance MAC VL in terms of overall success, laryngeal visualization, intubation difficulty scale and quality of laryngeal view. As compared with GlideScope VL, however, the channelled KingVision and Airtraq devices required a longer intubation time and cause a lower incidence of postoperative sore throat when tracheal intubation was performed by anesthesiologists with limited experience in patients with normal airways (56).

In a prospective RCT performed on patients with the predicted difficult airways, Glidescope VL enabled significantly better laryngeal visualization than Storz C-MAC VL, but laryngoscopy time, number of intubation attempts and intubation success rate did not differ between instruments (57). In a RCT comparing McGrath Series 5 and Storz C-MAC VLs in adult patients with potential difficult airways, Ng et al. (58) found that the C-MAC device allowed a quicker intubation time, a fewer number of intubation attempts and a greater ease of intubation compared with the McGrath device. In patients with cervical immobilization, Glidescope and Storz C-MAC VLs provided comparable laryngeal views, but the Storz C-MAC device had a higher first-attempt failure rate, and required significantly more intubation attempts and optimizing manoeuvers (59). Moreover, a RCT in obese patients undergoing bariatric surgery showed that Storz V-MAC VL significantly reduced the intubation time compared to McGrath Series 5 and Glidescope VLs, and required a fewer number of intubation attempts and a less frequent use of ancillary intubating devices compared to McGrath device (60). In addition, a multi-center, prospective, non-randomized trial comparing Storz C-MAC and KingVision VLs for prehospital emergency intubation showed that Storz C-MAC device provided significantly higher first-attempt success and overall success, and needed a less number of intubation attempts, but two devices were similar in term of intubation complication (61).

As Macintosh-type VLs combine the benefits of DL and VL in one device, a special difference between Macintosh-type and angulated VLs is that when video option fails with Macintosh-type VLs, intubator can simply take a direct view down the blade (62). When video option fails with the angulated VLs, however, intubator must discard because the angulated blade does not permit any direct view (9). As compared to angulated VLs, moreover, Macintosh-type VLs could reduce stylet use in patients with normal airways as it displaces soft tissues in the fashion of a DL and affords room for tracheal tube insertion (63). These feature of Macintosh-type VLs make them very suitable to serve as standard tools for routine intubation (10, 63).

In an observational study comparing performance characteristics of reusable and disposable GlideScope VLs, Sakles et al. (64) found that the reusable GlideScope VL had higher first-attempt success and overall success, and a significantly lower incidence of lens fogging and contamination. The above findings suggest that VL designs are important for clinical performances in different airway conditions; even slight design modification may significantly change the success rate, intubation time and use of adjunct manoeuvers. Thus, meaningful extrapolation from studies of one VL to another is difficult, not only for devices within a defined group (e.g., channelled Airtraq laryngoscope and Pentax- Airwayscope VL), but also especially between devices from different groups (e.g. Macintosh-type and angulated VLs) (65).

Due to the limited number of comparative studies, however, there is inconclusive evidence to recommend which VL design is more advantageous in various clinical situations. As mentioned above, each device has unique properties that may be advantageous in some conditions, but limiting in other situations (10). To manage various airway conditions expeditiously and safely, thus, VLs must be selected as to indications and anesthesiologists must master several different devices (4).

Should Videolaryngoscopy Be Used for All Intubations?

In current practice, clinicians usually use VLs when difficult intubation is predicted or following failed DL (1). Although this certainly is true, it misses the point which limits their use only to the intubation predicted to be difficult or proven difficult after failed intubations with a DL. In fact, success with the application of any device is probable to be increased as experience is accumulated. If VL is used for all patients, experience and skill would undoubtedly increase, thus, number of intubation attempts and complications of multiple attempts would decrease, and patient care would improve (10). It has been suggested that the optimal VLs should be offered to all patients without significant limitations and not only in those considered most difficult (12).

By assessing the use of VL among medicine fellowship programs training physicians in critical care medicine, Silverberg et al. (66) showed the most common reasons why VL had not been used as the primary intubation device in current practice. They reported that VL was used as the primary teaching device only in 16% of training programs and was never used in 9% of training programs, despite being available. In fact, most of current airway training programs do not include videolaryngoscopic intubation training in the minimal skill set acquired by a trainee during an airway rotation (67).

Furthermore, current difficult airway algorithms are developed as rescue guides in the event of difficult or failed DL, and these algorithms rely on VLs as rescue tools for difficult or failed DL (24- 26). There is no evidence-based difficult airway algorithm where tracheal intubation relies mainly on VL. If VL is used as the first- line intubation device, thus, there would be the needs to revise airway management algorithms and adopt a strategy to manage VL failure (68).

Other barriers against using VLs as primary intubation devices are likely to be their performance controversy and cost (10). Given that VL does not offer anything more than DL when tracheal intubation is performed by experienced operators in patients with easy airways and cannot give a 100% success rate in patients with difficult airways, some anesthesiologists have appealed that DL should continue to be taught and practiced, and VL should not replace DL in patients with normal or difficult airways (9, 69). Anesthesiologists quite rightly consider themselves experts in all matters airway, but nothing can ensure intubation success regardless of using any device. It is important to take all necessary steps to maximize success rate and improve patient safety. One key of such step is selecting the best tool for the job. VL has shown tremendous advantages, especially in airway management teaching, effective supervision, visualization of the larynx and tube passing through the glottis, and team coordination. The concern on the VL performance may be attributable to the current expertise of the user and the efficacy of teaching intervention on skill acquisition. Just like Evans and McCahon described (70), the more I practise the VL, the luckier I get. Thus, we believe that with further refinements of technology, improvement of skill training and increment of VL clinical use, this argument would no longer be the case.

Finally, is cost really an issue? The costs of

VLs have significantly decreased over recent years and most devices do not cost more than a syringe infusion pump. Thus, buying VLs for each operating room is not an unsurmountable investment. Disposable blades do cost in the range of about 10 US dollars and will surely become cheaper if they are used for all intubations. If a cost of 5 US dollars is achieved, the cost of a disposable blade is the same as that of a tracheal tube (71). When the costs of managing the delays, alternative techniques and complications of difficult or failed intubation are considered together, the gap is perhaps not as large as might be expected (10). Thus, we agree with Zaouter et al. (71) that there is now robust evidence supporting the use of VL for all intubations.

Will Increasing Use of Videolaryngoscopy by Residents Decrease Their Skill with Direct Laryngoscopy?

There is a concern that increasing use of VL by residents in clinical practice will decrease their skill with DL, which is generally regarded as a vital technique in the armamentarium of anesthesiologists (13, 69). This is likely not a justified concern, because many of VLs on the current market have combined VL/DL blades available. For example, Storz C-MAC VL is available in a variety of Macintosh DL blades, including sizes 2, 3 and 4 and Miller sizes 0 and 1. Similarly, Glidescope system is available with a Direct mode using a Macintosh DL blade (size 3.5), and recently a series of Titanium mode using Macintosh DL blades (sizes 3 and 4) have been introduced. McGrath MAC VL has three Macintosh DL blades (sizes 2, 3 and 4) (1). Thus, residents can practise DL using one of these devices including VL/DL blades.

In fact, teaching DL to the student may be associated with anxiety for both teacher and student. This can be attributable partly to the fact that the teacher cannot see what the student is (or is not) visualizing during the procedure (4). In contrast, VL provides a shared view for teacher and student; i.e., the high-quality, magnified airway pictures on video monitor allow teachers to explain the anatomy of the upper airway and the procedures of laryngoscopy and intubation to students (1). When a student is performing intubation, moreover, the teacher can see the monitor and provide a real-time feedback. In this way, a student will be able to finish an intubation himself without the teacher taking over. With the VL, thus, the “peer over my shoulder” teaching method of DL is displaced, considerable time is saved and many unessential intubation attempts can be avoided (10). This is especially useful for rapid sequence inductions and in patients at risk of hypoxia.

Several studies have demonstrated that compared to the training with the DL, video-assisted instruction with a combined VL/DL device may shorten the learning curve of tracheal intubation for students, improve intubation success rate and decrease rate of oesophageal intubation (72-75). Following training, moreover, the novices trained by using a combined VL/DL device perform better with respect to number of intubation attempts, needs of adjunct maneuvres and teeth trauma in simulated difficult airway conditions compared to those trained by using a Macintosh DL (76). These results indicate that using a combined VL/DL device may allow residents to learn DL more quickly and effectively.

In addition, Wolf et al. (77) compared the transfer of skills from VL to DL and vice versa using KingVision VL and Macintosh DL and found that following an AHA airway management course, transfer of skills from VL to DL was better than vice versa. Thus, they concluded that for global skill improvement in an airway management course for novices, only teaching VL may be sufficient.

Conclusions

Compared with DL, VL can provide a better laryngeal visualization and a higher intubation success rate in patients with difficult airways. Furthermore, available evidence supports that VL is likely to become a primary intubation tool. However, there are several different-type VLs available, and their efficacies are different between devices due to various designs and shapes. There is no sufficient evidence to recommend one specific device over another for use in airway management. Decisions regarding VL selection are based mainly on available resources, cost restrictions, personal preference and experience, etc. Furthermore, it is not clear whether difficult VL can be predicted preoperatively, and when VL may fail. Thus, anesthesiologists must clearly understand the procedural nuances and develop the skill with any VL they plan to use in clinical practice. Ideally, such devices should be available in all sites where tracheal intubation is performed. We believe that with increasing use of VL in airway management, experience and skill will undoubtedly increase, and the evidence will suggest that the attempt numbers and complications of intubations may be decreased, and patient safety can be improved.

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