A Clinician’s Guide to Video Laryngoscopy: Tips and Techniques

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A Clinician’s Guide to Video Laryngoscopy: Tips and Techniques

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Introduction.
Indications for GlideScope Video Laryngoscopy

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The GlideScope video laryngoscope (Verathon) has been designed for targeting difficult airway management. This indication was tested and found to be highly effective because the main issue, as expected, was the anterior location of the larynx placing this out of the direct laryngoscope line of sight view. The active physical heating of the viewing lens area enabled the device to resist fogging and bloody contamination. Cooper et al suggested using the video device in place of a direct laryngoscope in normal airway management because of the regular occurrence of failed laryngoscopy, which is defined as failure to visualize the glottis throughout the act of intubation well enough to execute the procedure with certainty.1

Endotracheal intubation may be successful with failed laryngoscopy, but this is termed a “near miss” and is not acceptable. Airway practitioners have expanded the applications where the GlideScope video laryngoscope (GlideScope® GVL, GlideScope® Ranger, GlideScope® Cobalt; Verathon) devices have been used in the following ways2-7:

1. First choice: elective oral intubation.
2. First choice: nasal intubation.
3. Anticipated difficult laryngoscopy
   a. GlideScope awake intubation strategy; and
   b. GlideScope rapid-sequence induction.
4. Unanticipated failed laryngoscopy.
5. Combined use of the GlideScope and flexible video or fiberscope for management of the extremely difficult airway.
7. Combined use of the GlideScope video laryngoscope and the video stylet class of devices. The GlideScope serves to allow the rigid visualizing stylet to be accurately guided to the glottis and ultimately deliver the endotracheal tube.
8. Operating room: ear, nose, and throat used to document the recurrent laryngeal nerve status after neck operations.
9. Placement of esophageal echo probes under direct vision.
11. Emergency department applications
   a. Bloody contamination in the airway;
   b. Trismus;
   c. Combative and drug-dependent patients;
   d. High-risk intubation: severe acute respiratory syndrome and Ebola virus; and
   e. Inline stabilization for trauma: unknown neck status.
12. Intensive care unit (ICU) applications
   a. Endotracheal extubation backup support strategy;
   b. GlideScope-assisted endotracheal tube-exchange catheter strategies; and
   c. Placement of nasogastric tubes to avoid lung-feeding errors.
13. Air medical applications
   a. Critical care air transport issues; and
   b. Air medical in-flight intubation procedures.
14. Teaching airway anatomy to novice airway managers.
15. Telemedicine: Wi-Fi, G3, or G4 transmission for coaching, military secure networks, civil wide-area networks, optical trunks, or cell-node services.
16. Pediatric
   a. Neonatal ICU (NICU) applications: intubation of low-birthweight infants;
   b. NICU confirmation of stability and position of endotracheal tubes; and
   c. Intubation “syndrome children” (eg, Pierre Robin Sequence).

References
7. According to an e-mail from K Gil (February 2009).
Ia. Transitioning From Direct to Video Laryngoscopy

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Following the introduction of the straight (Miller, 1941) and curved (Macintosh, 1943) laryngoscope blades, laryngoscopy had remained largely unchanged for more than 50 years. With the development of rigid fiberoptic laryngoscopes—the first generation of video laryngoscopes1—clinicians benefited from advances such as eyepieces that could be attached to optional video cameras, such as the Bullard (Gyrus ACMI), the WuScope (Achi Wu), and the UpsherScope (Mercury Medical), or used with a prism to achieve the same effect (EVO, Truphatek; Viewmax, Teleflex). Rigid fiberoptic laryngoscopes placed the observer’s eye close to but above the glottis, allowing for controlled insertion and advancement of an endotracheal tube (ETT) between the vocal folds. Nonetheless, these rigid fiberoptic laryngoscopes failed to gain traction within the anesthesia community.2,3

Fiberoptic laryngoscopy provided a non–line-of-sight view and the use of a dedicated monitor with an attached video camera embodied the essential concepts of video laryngoscopy (VL). Weiss’s modified Macintosh direct laryngoscope, incorporated an ultra-thin fiberoptic bundle into an angulated blade,4 and the Storz (Karl Storz Endoskope GmbH) DCI Video-Macintosh5 coupled a proprietary light source, video processor, and monitor with a Macintosh laryngoscope. Both of these devices looked and behaved in a familiar fashion yet had the functionality of video laryngoscopes. They obviated the need to achieve a line-of-sight view by tissue compression, distraction, and external force.

Video laryngoscopes lack the versatility of flexible bronchoscopic intubation (FBI)—they cannot be introduced through the nose or a tracheostomy, precisely position a bronchial blocker, double-lumen tube, or perform pulmonary toilet—but they do offer some advantages. They are easy to use, less fragile, and provide a supraglottic vantage point.

In 2001, Canadian surgeon John A. Pacey, MD, was the first to embed a miniature video chip (complementary metal oxide semiconductor) into a modified Macintosh laryngoscope—the GlideScope video
laryngoscope (GVL, Verathon). GlideScope video laryngoscopes proved to be easy to use and highly effective, even when used by operators relatively inexperienced with the device. When compared with the direct laryngoscope, the GlideScope GVL consistently provided comparable or superior laryngeal exposure in early and subsequent studies. The original GlideScope GVL was black and white and had a 7-in proprietary liquid crystal display (LCD). Subsequent versions used a lower profile blade (14-mm) and a color video chip. Several other products recently have been introduced by other manufacturers, including the McGrath Series 5 (Aircraft Medical), the C-Mac (Storz), the AWS-100 (Pentax), and the disposable optical Airtraq (Pro dol, Spain).

**Current Options for Video Laryngoscopy**

Channeled video laryngoscopes have a tube slot to facilitate delivery of the ETT. Essentially, the scope rather than the ETT must be aimed at the larynx because the ETT cannot be independently manipulated. The GlideScope GVL and McGrath VL have blades that are angled approximately 60 degrees upward. With these devices, the larynx often is not directly visible despite an excellent view on the monitor. Thus, a stylet should always be used. On the other hand, the blades of the Storz DCI and C-Mac resemble a conventional Macintosh and therefore it often is possible to intubate without a stylet. The reduced upward deflection means that the view obtained by the video chip is more dependent on a wide-angle camera than its upward orientation and often, external laryngeal pressure may be required. The C-Mac has been introduced only recently and there have been no studies to evaluate its performance.

Of the video laryngoscope systems, the GlideScope GVL has been most extensively studied. Published reports show that compared with direct laryngoscopy (DL), VL and the GlideScope GVL in particular, results in improved laryngeal exposure, requiring less force, and cervical manipulation (Figure). Several studies have observed that teaching laryngoscopy is more easily achieved with a video rather than a direct laryngoscope, although only the Storz DCI and the C-Mac are used similarly to a direct laryngoscope. When using other video laryngoscopes, a somewhat different technique is being demonstrated, although it still serves as a useful way of showing airway anatomy, engaging those in attendance and generating confidence and enthusiasm. Naïve laryngoscopists prefer VL to DL, learn VL more quickly than either DL or FBI, and it is possible that they acquire DL skills more quickly after VL exposure. Nouruzi-Sedeh et al analyzed the success rates of novice operators using
When performed by novices, the results showed a success rate of 93% with VL (using Glidescope video laryngoscope) compared with 51% with DL. Video capture permits playback and analysis under less stressful conditions and likely promotes skill acquisition. Such video capture also might become an integral part of continuing quality improvement, and clinical documentation. This would be especially helpful when emergent airway management is provided by non-physicians as a delegated act.

**Barriers in Airway Management**

Advances in airway management have been stifled by imprecise and misleading terminology. For example, the American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway and other studies refer to “difficult” or “awkward” airways when laryngoscopy fails to visualize the glottis, despite multiple attempts. A meta-analysis by Shiga, involving more than 50,000 adults, found that unanticipated failure to visualize the airway occurs in a mean of 5.8% of cases. Adnet found that moderate difficulty was encountered in 6.3% of DLs attempted in the operating room and 16.1% outside of the operating room. It is
Transitioning From Direct to Video Laryngoscopy

important to acknowledge that laryngoscopy that fails to identify any part of the larynx is neither difficult nor awkward—it is a failed laryngoscopy—and when this occurs, it is most commonly dealt with by repeated laryngoscopic attempts. This is much like landing an airplane while being visually impaired. Although such a landing may be successful, most would regard it as a “near miss.” For decades, we tolerated the necessity of blind and repeated attempts because we lacked better tools; but the evidence demonstrates that multiple attempts are associated with minor and serious morbidity. Our predictive tests for a difficult laryngoscopy are neither sensitive nor specific. They are even less predictive when VL is used. In the meantime, we should be very clear that the traditional metrics of airway assessment are (marginal) predictors of difficulty for DL and do not identify a difficult laryngoscopy or intubation performed by an alternative technique (such as VL).

Video Laryngoscopy: An Appropriate Alternative

So what is the role of the video laryngoscope in today’s airway management? Although most video laryngoscopes are capable of affording better laryngeal exposure, practice at delivering and advancing the ETT increases the operator’s success. Such experience is best acquired when no difficulty is anticipated. For most, this will promote better recognition of the limitations of both the device and the operator’s skill. As experience increases, many known difficult DLs will in fact turn out to be easy VLs. When there is uncertainty about the appropriateness of VL, it is possible to perform awake VL or combine VL with FBI. These permit the maintenance of spontaneous ventilation and/or the ability to visualize ETT advancement to and through the vocal cords. With increasing use of VL, there undoubtedly will be pressure to reassess our airway algorithms for the management of airways we have traditionally regarded as difficult.

References


It can be challenging to teach someone how to use a video laryngoscope. Many experienced practitioners feel they already know what they are doing and expect use of a video laryngoscope to be intuitive. On the other hand, novice practitioners who have some experience with direct laryngoscopy (DL) expect intubation with a video laryngoscope to be much easier. Although the GlideScope video laryngoscope (GVL, Verathon) is easy to use, some practitioners who are accustomed to using specific techniques may need time to readjust their techniques using the GlideScope GVL. The reality is that there are significant differences in the use of the devices, the view obtained, and the technique needed to insert the tube into the trachea. These distinctions necessitate a curriculum for GlideScope GVL and intubation that is different from traditional DL and intubation.

For the purposes of this section the term student will be used to describe the novice user of the GlideScope GVL. The student could be any anesthesia provider or other health professional who wants to learn how to intubate using the GlideScope GVL.

Teaching Techniques for the GVL

When introducing an anesthesia provider to the GlideScope GVL for the first time, the basic functions of the device and some tips and challenges should be reviewed before the patient is in the operating room. It should be noted that the interincisor distance needed for GlideScope GVL intubation is smaller than that needed for DL. This may not be obvious because the GlideScope blade is not considerably thinner than the blade of traditional Miller or Macintosh laryngoscope blades. However, when one is performing DL, the final position of the blade will be at an angle that is shallow relative to the plane created between the patient’s upper and lower incisors. The GlideScope GVL’s blade, on the other hand, has a relatively curved design that allows the portion between the teeth to be relatively perpendicular to the interincisor plane. The thickest portion of the thickest GlideScope GVL blade is less than 15 mm, so patients with an interincisor distance of 2 cm or larger usually can accept the GlideScope GVL blade easily.
The location of the camera, light-emitting diodes (LEDs), and heating element are reviewed. Turning on the device prior to starting the anesthetic induction of the patient serves 2 purposes: First, it confirms that the device is working and that a clear image can be obtained before the patient has been rendered unconscious. Second, the lens has a chance to get warm before being inserted in the airway, thereby reducing fogging.

There are important differences between the direct laryngoscope and GlideScope GVL. First is that GlideScope GVL intubation requires that the endotracheal tube (ETT) and stylet be prepared in a manner different than for DL. The stylet should be lubricated to facilitate passing the ETT off the stylet. When using the GlideRite® Rigid Stylet (Verathon), it may be helpful to load the tube with “reverse camber.” This is where the tube is spun 180 degrees from its usual orientation on the stylet. When this is done the radio-opaque stripe is on the concave side of the tube rather than the convex side where it usually resides. Loading the tube with reverse camber allows it to pass into the larynx more easily. The thick plastic end of the GlideRite Stylet engages the 15-mm adapter on the end of the ETT and prevents it from spinning to its normal orientation.

When using a standard malleable stylet with the GlideScope GVL it must be bent differently than its usual DL shape. The GlideScope user’s manual suggests bending the stylet tip at least 90 degrees. The optimal configuration may not be obvious from this description. A useful technique is to load the ETT on the stylet and then bend the stylet so that the shape approximates the convex surface of the GlideScope GVL blade to be used (Figure 1). When performing DL, one usually bends the end of the stylet coming out of the 15-mm adapter to the right so that it does not interfere with vision during laryngoscopy. When preparing a stylet for Glide Scope GVL it often is helpful to bend the end of the stylet “backward” so that it will be pointing toward the person performing the intubation. This allows the operator to easily withdraw the stylet with his or her thumb while advancing the tube with his or her fingers (Figure 2).

This is important because the relative motion of the tube and stylet for GlideScope GVL intubation is different from that for DL intubation. Often during DL, the stylet is removed after the tube is in the trachea. The tube is motionless and the stylet is pulled back. The optimal motion with the GlideScope GVL is to have the stylet be motionless and advance the tube over the stylet. It is helpful to have the student practice advancing the
Teaching Glide Scope Intubation

ETT off the stylet in this manner prior to his or her first Glide Scope GVL intubation. Once these preparations have been made, the intubation technique should be discussed.

Tips on Intubation

When teaching in the operating room, 1 or 2 key teaching points should be made; and the student should be left with the following aphorism for intubation with the Glide Scope GVL:

1. The hard part of DL is obtaining a good view. Once you can see the larynx you can almost always intubate the trachea.
2. With Glide Scope GVL intubation the inverse can be encountered. It usually is easy to see the vocal cords and the challenge can be passing the tube into the trachea.

As the larynx comes into view on the display, the student should be pleased with a Cormack-Lehane grade II view. The more the blade is lifted, the more anterior the larynx becomes, making it harder to insert the tube.

Challenges With Video Laryngoscopy

There is an adage that in order to understand a tool one needs to know how it can be misused or how it can cause injury. Therefore, it is
It is very important that the anesthesia provider be aware of potential complications associated with the GlideScope GVL.

There have been case reports of laceration of the soft palate and palatoglossal arch caused by inserting the blade or tube without directly looking in the patient’s mouth. It is very easy to get in the habit of looking at the video display during these processes. Students should be instructed to watch the blade until the tip goes out of view behind the tongue. If the student starts to look at the screen too early, the instructor should cover it with his or her hand and remind the student to look in the patient’s mouth.

Once the larynx has been adequately visualized, the tube should be handed to the student, and he or she should be instructed to watch the tube until the tip goes out of view behind the tongue. Once the tip of the ETT can be seen on the monitor, there is a 2-step process to facilitate intubation. First, the operator must place the tip of the tube into the laryngeal opening. The tip must be directed anterior to the arytenoid cartilages. Once the tip is properly located, the tube must be advanced off the stylet and into the airway. This is where practice delivering the tube off the stylet is valuable. If the student is having trouble manipulating the tube off the stylet, the instructor should provide assistance by holding the stylet and instructing the student to advance the tube. Another approach is to alternate withdrawing the stylet approximately 2 to 5 cm
followed by advancing the tube the corresponding amount, then alternating, stylet out, tube in, stylet out, tube in, and so on.

If the axis of the tube is not well aligned with the axis of the larynx, it can be difficult to advance the tube. If this occurs there are 3 maneuvers that can help: 1) withdraw the GlideScope GVL slightly, trying to lift the tongue, but not the larynx in an effort to bring the axis of the tube into better alignment with the axis of the larynx; 2) spin the tube as it is advanced off the stylet to minimize the tendency of the tube to curve into the anterior wall of the trachea; 3) remove the tube and reload it with reverse camber.

If the patient has a small oral aperture occasionally one will encounter difficulty placing the tube in the mouth after the GlideScope GVL is in proper position. The student can try sliding the GlideScope GVL to the left, allowing more room for the tube to be inserted to its right side. Another technique for the small mouth problem is to remove the GlideScope GVL, then insert the tube until it disappears behind the tongue, and then reinsert the GlideScope GVL.

Because the instructor can see the tube’s position, its proper location is easily confirmed. Once the tube is in the proper position with the cuff 5 to 10 mm below the vocal cords, the GlideScope GVL is carefully removed from the mouth while holding the tube in place. The GlideScope GVL is disconnected from the video cable, the cleaning cap is placed over the video connector port, and the blade is placed in an appropriate location for cleaning and disinfection. After the student has properly secured the ETT, the function of the cleaning cap can be demonstrated.

References
Although the GlideScope video laryngoscope (GVL, Verathon) strongly resembles a conventional direct laryngoscope, the significant advantages conferred by its video capability require an adjustment in technique. With conventional direct laryngoscopy (DL), the hands, devices, and targets are all in a “real-world” line of sight, and simple hand-to-eye coordination is required. In video laryngoscopy (VL), certain aspects are best performed in the same concrete spatial environment, while others capitalize on the superior view and access provided by the video image. It is important to distinguish which VL steps work best using direct hand-to-eye coordination, and which are best done in the video environment. Accordingly VL can be approached using a 4-step technique:

1. introduce the laryngoscope;
2. obtain the best view;
3. introduce the endotracheal tube (ETT); and
4. intubate.

Thinking of VL in this way allows one to capitalize on the advantages of direct sight for certain activities and of video imaging for others. In step 1, the operator uses direct sight to insert the laryngoscope in the mouth and then the video-imaging screen to obtain the best possible view of the glottis (step 2). In step 3, the eyes then return to the oral pharynx to introduce the ETT and then back to the video screen to complete the act of intubation (step 4).

**Step 1: Introduce the GlideScope GVL**

With the patient appropriately positioned, the operator uses the left hand to introduce the GlideScope GVL into the midline of the oral pharynx and gently advances until the blade tip is past the posterior portion of the tongue. This step is done using direct vision. In other words, the operator is looking directly into the patient’s mouth, as is the case for DL.
Step 2: Obtain the Best View

With the scope now inserted, the operator turns his or her eyes to the video screen in order to manipulate the scope and obtain the best view of the glottis. Unlike conventional laryngoscopy, the GlideScope GVL is a midline instrument and no lateral displacement of the tongue is required. Additionally, and also in contrast to DL, the glottic view is optimized by a combination of advancing or withdrawing the laryngoscope slightly while increasing the tilt on the blade to seat the device in the vallecula or on the posterior surface of the epiglottis to obtain the best glottic view. All of this is done using video visualization with the eyes directed at the video screen the entire time. When the GlideScope GVL is appropriately positioned, the glottic aperture is seen in the center of the upper third of the video display.

Step 3: Introduce the ETT

Usually, the video image of the glottis is a Cormack-Lehane grade I or II view and the operator immediately is tempted to insert the ETT and attempt to navigate it through the glottic aperture while continuously visualizing the video screen. In fact, it is better to maintain the laryngoscopic position in the mouth with the left hand but to avert the eyes from the video screen back to the patient’s open mouth. The ETT, which is shaped by the stylet to match the bend of the GlideScope GVL blade, is then inserted under direct vision until the distal tip of the ETT is judged to be very near the distal tip of the laryngoscope blade. This relationship is quickly and easily achieved, but only then does the operator return his or her eyes to the video screen.

Step 4: Intubate

Returning one’s eyes to the video screen allows one to see the glottic aperture as before (sometimes slight readjustment of the GlideScope blade is required) and, near it, the tip of the ETT. Using video visualization, the ETT is then advanced on a smooth curve through the glottis and intubation proceeds as described elsewhere in this manual. Viewing the entire insertion step on the video screen allows the operator to quickly become facile with the notion of gently rotating or angling the tube using the right hand to redirect as necessary.

Summary

In summary, the views of the 4 steps are as follows:
1. “in the mouth” to introduce the laryngoscope;
2. “at the screen” to obtain the best glottic view;
3. “in the mouth” to introduce the ETT; and
4. “at the screen” to intubate.

Over several years of working with both novice and experienced video laryngoscopists, I have found that this simplified 4-step approach makes intubation easier and more intuitive.

References


II. Teaching Video Laryngoscopy In the Operating Room

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Tracheal intubation, particularly in patients with an unanticipated difficult airway, remains a frequent cause of clinical morbidity. Although adherence to a strategy, such as the American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway\(^1\) is an important approach to reducing complications during airway management; instruments that make tracheal intubation easier also are vital. This section summarizes the issues that arise when teaching the use of GlideScope video laryngoscopes (Verathon) in the operating room setting (Figure).

Clinical experience with GlideScope video laryngoscopes has shown that they are easy to use, even in some patients who ordinarily are very difficult to intubate. In addition to the ordinary use of GlideScope video

**Figure.** Teaching demonstration using the original GlideScope.
laryngoscopes, they frequently are used for awake intubation\(^2\) and as an adjunct to fiberoptic intubation.\(^3\) In the educational setting, the fact that both the trainee and the instructor can simultaneously see what is happening is of enormous teaching benefit. First of all, the anatomical structures can be readily shown to the learner. Second, because real-time correctional information can be provided easily, the intubation process is simple and safer.

**Tips and Techniques**

Intubation using GlideScope video laryngoscopes can be simplified when applying some important teaching points:

1. Successful oral endotracheal tube (ETT) placement always requires some form of stylet, such as the GlideRite Rigid Stylet (Verathon)—a reusable rigid stylet—or the Satin-Slip (Mallinckrodt) disposable intubating stylet. Otherwise the ETT is floppy and very hard to direct through the vocal cords. A stylet is not used for nasal intubation.

2. The primary limitation in using the GlideScope is not in getting a good view of the glottis, but rather in manipulating the ETT through the vocal cords. This is because the ETT tip often tends to hit against the anterior tracheal wall. When this happens it is often helpful to retract the stylet by 3 to 5 cm, as this often advances the ETT into a more favorable position. Sometimes, even when the stylet is removed completely, the ETT still abuts against the anterior tracheal wall; in these cases the ETT should be twisted by 180 degrees.

3. When initially placing the GlideScope video laryngoscope blade or the ETT, learners should first look into the patient’s mouth and not at the monitor, in order to prevent injury to any oropharyngeal structures.

**References**


III. Pediatric and Neonatal Patients

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This section addresses the use of GlideScope video laryngoscopes (Verathon) in children and infants, including the selection of appropriately sized GlideScope video laryngoscopes, tips for oral and nasal intubations, solutions to common pitfalls, and some unique applications.

Size Selection

The Table illustrates GlideScope video laryngoscopes available for use in pediatric practice and the suggested blade sizes. The best option for premature and term neonates is either the Cobalt Video Baton 1-2, or the single-use GlideScope Ranger combined with the GVL 1 Stat or GVL 2 Stat single-use blades. These blades optimize the amount of usable working space in the pharynx of both premature and term infants. Clinicians may find that subtle design differences allow both the GlideScope Ranger and the Cobalt Video Baton 3-4 GVL 3 Stat to outperform the standard GlideScope GVL 3 at the lower end of the suggested

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<td>1.8 -10 kg</td>
<td>10 kg to adult</td>
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<td>Ranger Single Use</td>
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patient size range (the anecdotal experience of the author suggests that the GlideScope Ranger GVL 3 may be able to perform reliably well down to at least 8 kg).

**Tips for Oral and Nasal Intubation**

*Insertion and Advancement*

The GlideScope video laryngoscope should not advance along the right side of the tongue, as is procedure with a conventional direct laryngoscope blade. Rather, the GlideScope video laryngoscope should be inserted in the midline or even closer to the left side of the mouth. With passage through the pharynx, the tip of the GlideScope video laryngoscope is then directed such that in the final position, the blade tip and camera of the GlideScope video laryngoscope are directed centrally, but the more bulky proximal portion of the blade will remain toward the left-hand side of the mouth. This provides a maximal amount of “working space” in the mouth and pharynx without compromising the laryngeal view. This approach will initially feel “counterintuitive” to experienced practitioners.

*External Manipulation*

When performing endotracheal intubation in neonates and infants, it is helpful (if not essential) to hold the GlideScope with a sufficiently distal grip to enable the pinky of the operator’s left hand to maneuver the larynx into a position that will provide the best view. Typically, this is either simple backward pressure or a Backward, Upward, Rightward Pressure (BURP) maneuver.

*Oral Intubation*

The routine use of a stylet is suggested. Curving the endotracheal tube (ETT) into a shape matching the curvature of the GlideScope video laryngoscope permits the ETT to be directed into the glottis with a minimum of effort. This curved shape also may be optimal in patients with a small mouth and/or pharynx. In children with normal airway anatomy, oral endotracheal intubation also can be readily accomplished with a stylet that bends the ETT in the more typical “hockey stick” shape.

*Nasal Intubation*

Using the techniques described above, one should ensure that there is a maximal amount of space available for directing the ETT by means of the smallest suitable pair of Magill forceps. It occasionally may be
unnecessary to use the Magill forceps if the ETT is naturally directed into the glottic opening (ie, as may be seen with ETTs that have not been softened by warming). As with conventional nasotracheal intubation, passage of the ETT through the glottis may require rotation of the ETT or forceps deflection of the ETT toward the axis of the trachea. Both maneuvers are readily visualized with the GlideScope video laryngoscope.

**Potential Challenges**

The following are potential challenges associated with the use of GlideScope video laryngoscopes.

1. The tendency to insert the GlideScope video laryngoscope too deeply (esophageal view) is a common cause of failing to obtain the desired laryngeal view. Observing the view while carefully withdrawing the GlideScope video laryngoscope usually will produce the desired view. With experience, one becomes accustomed to observing blade advancement with the GlideScope video laryngoscope monitor and integrating this information with the tactile sensations that accompany smooth insertion of the blade.

2. Some neonates or infants may present with insufficient room to maneuver the ETT within the mouth and pharynx. This is remedied with the techniques mentioned in the previous section.

3. In some neonates or infants the GlideScope video laryngoscope may initially provide an anterior view of the larynx (ie, only arytenoids or posterior glottis visible at the top of the monitor screen). The operator should avoid the tendency to attempt to improve the view by advancing the GlideScope video laryngoscope further. Rather, he or she should optimize the view by either maintaining blade position or slightly withdrawing the GlideScope video laryngoscope blade while applying the external manipulations mentioned previously (backwards pressure or the BURP maneuver). Furthermore, the “shared view” provided by the GlideScope video laryngoscope monitor can permit an assistant to effectively aid in obtaining and maintaining the best possible laryngeal view. It also may be worthwhile to determine whether blade insertion that lifts the epiglottis or blade insertion into the vallecula provides the best view. Finally, in a subset of patients, the use of a shoulder roll may further improve the view.

4. Uncertainty about the trajectory of an ETT or the position of Magill forceps is rectified by carefully withdrawing the GlideScope video laryngoscope to provide a broader view of the laryngeal and
pharyngeal structures. This will aid in the location and direction of the ETT and forceps. As well, this may minimize the risk of inadvertent trauma to the soft tissue structures such as the palate, tonsillar pillars, and uvula.

5. The GlideScope video laryngoscope’s anti-fog system requires about a 10-second warm-up period to avoid foggy images. Pharyngeal secretions also may impair the view or result in excessive light reflection. Suction is accomplished readily under GlideScope video laryngoscope visualization.

**Unique Applications**

**Endotracheal Tube Exchange:** GlideScope video laryngoscopes are able to provide both the operator and the assistant with an excellent view of the larynx that permits the replacement ETT to be pre-positioned in a fashion that facilitates expedient insertion immediately following withdrawal of the original ETT.

**Insertion of Other Devices:** GlideScope video laryngoscopes may be used to facilitate the esophageal insertion of nasogastric tubes, feeding tubes or, in some circumstances, transesophageal echocardiography probes.
IV. Bariatric Patients

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The prevalence of obesity (body mass index >30 kg/m²) continues to be a health concern in the United States; consequently, obese patients are presenting for anesthesia and surgery with increasing frequency. Although debate is ongoing, many clinicians agree that laryngoscopy and tracheal intubation often are more difficult in morbidly obese patients than in patients within the normal weight range. This appears to be especially true in those with a short, thick neck because large amounts of oropharyngeal fat often are present. For instance, one study indicated that 16% (19 of 118) of morbidly obese patients had Cormack-Lehane grade III or IV views during direct laryngoscopy (DL). Additionally, morbidly obese patients are frequently more difficult to ventilate, and they tend to become hypoxic quickly because of a reduced functional residual capacity.

In a study by Marrel et al, 80 morbidly obese patients undergoing bariatric surgery were randomly assigned to intubation using either a video laryngoscope or direct laryngoscope. They found that better Cormack-Lehane views were obtained using a video laryngoscope rather than a direct laryngoscope in this study population. Studies of this kind match my personal experience in providing anesthesia for patients undergoing bariatric surgery, and I almost always ensure that a GlideScope video laryngoscope (GVL, Verathon) is immediately at hand when providing anesthesia for these patients. Typically, a GVL size 4 or 5 blade is used with this patient population.

When intubating an obese patient, it is my practice, partly based on studies such as those of Collins et al and Rao et al to use a “ramped” position rather than the usual “sniff” position. Such positioning is encouraged regardless of whether DL or video laryngoscopy (VL) is used. A “ramped” position is easily achieved by stacking blankets underneath the patient’s shoulders and head until the ear canal and the sternal notch are horizontally aligned. This is sometimes called the head-elevated laryngoscopy position (HELP).
Case Vignette

Awake GlideScope intubation in a 300 kg (660 lb) man with a severe cardiomyopathy for bariatric surgery.

The patient was first positioned supine in the exact position needed by the surgical team. Dexmedetomidine (Precedex, Hospira) was used for light sedation. No glycopyrrolate was given. A pulmonary artery line, in situ via the right internal jugular vein, showed pressures of about 60/30 mm Hg. An awake arterial line was placed in the right radial artery, necessitated by the cardiomyopathy. Viscous 2% lidocaine (30 mL) was administered via a gauze-wrapped tongue depressor, which the patient sucked on. Most was subsequently suctioned away. Using the MADgic Laryngotracheal Atomizer (Wolfe-Tory Medical), 4% lidocaine via 5 mL was given blindly at first, and another 5 mL was sprayed directly on the glottic structures using the GlideScope GVL for guidance. When the GlideScope GVL was introduced a second time, the endotracheal tube was passed into the glottis without difficulty. The patient was then induced with etomidate, having only a 10% ejection fraction. A transesophageal echocardiogram probe placed after the induction of anesthesia showed severe global hypokinesis in the 4-chamber view. An epinephrine infusion was used for inotropic support. The patient did well and was unintubated in the intensive care unit when seen postoperatively.

References

V. Special Cases in Neuroanesthesia

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Airway management in neuroanesthesia is sometimes challenging because of the nature of the cases and the occasional need for urgent and expedient endotracheal intubation (ETI). The neurosurgical patient may present with a brain tumor or cerebral aneurysm requiring carefully controlled laryngoscopy with minimal hemodynamic response. The patient also might present with acromegaly for pituitary surgery or may have a previous history of difficult intubation. The unanticipated difficult airway becomes a greater challenge when one also is focused on potential rupture of a cerebral aneurysm or increased intracranial pressure (ICP). Other challenges include the patient in need of cervical spine surgery who has limited neck movement, as well as the patient in a remote location who is in need of diagnostic procedures.

Applying Video Laryngoscopy to Neurosurgical Patients

If performed incorrectly, laryngoscopy and intubation can severely compromise intracranial dynamics and increase morbidity. Both the sympathetic and parasympathetic nervous systems mediate cardiovascular responses to ETI. Acute increases in ICP and mean arterial pressure during laryngoscopy and ETI have been well documented. Video laryngoscopy (VL) is a new and useful technique in airway management and has many benefits for the neurosurgical patient. An adequate glottic view often is easily obtained during VL, and frequently is superior to that obtained by direct laryngoscopy (DL). The GlideScope video laryngoscope (GVL; Verathon) allows for indirect laryngoscopy without alignment of the oral, pharyngeal, and tracheal axes. An early study of 50 elective patients by Rai and colleagues demonstrated ease of use. The GlideScope GVL provided a Cormack-Lehane grade I view of the glottis in 44 cases and a grade II view in six cases. The view of the larynx was improved in almost half (23) of the cases. The success rate of intubation after the first 8 patients was 100%. Hemodynamic responses often are minimized if appropriate doses of anesthetic are given. The ability to demonstrate and confirm intubation also is extremely useful as laryngoscopy is sometimes obtained with the “head away” from the anesthesia machine.
Topicalization of the larynx and trachea can prevent increases in arterial blood pressure during intubation and positioning of patient. Several techniques using VL are beneficial for the neurosurgical patient. Following induction and mask ventilation, DL may be performed and local anesthetic sprayed into the larynx using a laryngeal tracheal anesthesia (LTA) kit (Abbott Laboratories). This allows one to assess and grade the laryngeal view as well as provide analgesia to the trachea. Additionally, one can observe the patient’s hemodynamic response and provide more narcotic, induction agent or β-blocker if needed. The GlideScope GVL is then used for laryngoscopy and ETI. This provides a comparison of the DL view and is well tolerated due to the application of anesthetic to the trachea. It also is possible to use the MADgie Laryngo-Tracheal Atomizer (Wolfe Tory Medical) for spraying topical anesthetics in the laryngotracheal region using the GlideScope GVL. This device can be shaped according to the curve of the GlideScope GVL and allows one to topicalize the airway prior to intubation in the awake or asleep patient.

Acromegaly is an endocrine disease resulting from a pituitary growth hormone-secreting adenoma, which ultimately results in changes in the outward appearance of the patient. Airway management challenges have been attributed to prognathism, macroglossia, and thickening of pharyngeal and laryngeal soft tissue. Schmitt found a 26% incidence of Cormack-Lehane grade III views on DL in acromegalic patients. At our institution, we have had excellent results using the GlideScope GVL as a primary or secondary instrument for intubating patients with acromegaly (Figure 1). The GlideScope GVL’s construction allows for easy navigation around the large tongue and usually provides excellent visualization of the glottic opening. Experience with the device is recommended in normal airways before use in a potentially difficult airway.

**Addressing Patients With Difficult Intubation**

Difficult intubation is well recognized as more common in patients with cervical spine disease. In particular, ankylosing spondylitis, rheumatoid arthritis, and Klippel-Feil abnormality are conditions that present additional difficulty. One of the problems in predicting difficult intubation is its incidence and the sensitivity and specificity of the tests used to detect it.

The patient who presents for elective surgery with symptoms of cervical myelopathy deserves careful airway management to avoid further injury. Intubation techniques described for the patient with a cervical spine injury are appropriate and best performed by experienced
practitioners. When possible, awake intubation (AI), followed by the demonstration of extremity movement, is ideal and recommended. When AI is not possible, or not essential, a technique that produces minimal head movement and airway maintenance is acceptable (Figure 2). During intubation under general anesthesia with neuromuscular blockade and manual in-line stabilization, the use of the GlideScope GVL produced better glottic visualization, but did not decrease movement of the nonpathologic C-spine significantly when compared with DL. A study comparing a variety of laryngoscopes in patients who were intubated with cervical spine immobilization showed that the GlideScope GVL and the Airway Scope AWS-100 (Pentax) video laryngoscopes required more time but reduced intubation difficulty and improved glottic view compared with the Macintosh laryngoscope.

Patients with cerebrovascular or spinal disease for interventional neuroradiology often require general anesthesia with ETI to ensure a motionless study. These patients may present with many of the considerations described previously (eg, increased ICP, changing neurologic status, hemodynamic instability), yet they will be anesthetized in a location other than the operating room. Other considerations include the occasional need for
a rapid-sequence induction or intubation on a flat table. The GlideScope, in particular the portable Ranger, is invaluable in this scenario.

In the patient with an anticipated difficult airway, awake fiberoptic intubation remains the standard of care, however, this view is gradually changing as a result of the success and ease of use of VL. Remarkably, the GlideScope GVL and the fiberoptic bronchoscope can be combined for additional success in the very challenging situation. Use of the GlideScope GVL and the GlideScope Ranger are promising in the intubation of the difficult airway as primary or rescue devices and have proved invaluable in the management of patients undergoing neurological surgery.

**Tips and Techniques**

1. The operator should always begin in the midline of the mouth, following the uvula as the GlideScope enters. If the blade is turned sideways for a small mouth opening or large chest, re-orient to the midline.

2. Obtain the “best view” possible by withdrawing the blade in the vallecula to reveal the epiglottis, vocal cords and arytenoid cartilages.

3. Use a stylet with a small curve at the end. The GlideRite Rigid Stylet works best.
4. Head position of the patient is important; a sniffing or slightly extended position is beneficial.

References


VI. Nasal and Awake Intubation

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Nasotracheal Intubation

When an individual is at rest, the normal human airway anatomy facilitates easy conduction of air from the nares to the trachea. Therefore, it should not be surprising that techniques such as blind nasotracheal intubation are possible, because a nasotracheal tube (NTT) will naturally direct itself toward the glottis. However, the most common technique for inserting an NTT—direct laryngoscopy (DL)—involves substantial distortion of the normal airway anatomy to sufficiently align the laryngeal, pharyngeal, and oral axes so that the user can visualize the vocal cords. With DL, the trachea is moved anteriorly, and as a result, the tip of a preformed NTT will tend to sit posterior to the glottis, requiring the frequent usage of Magill forceps to lift the tip of the NTT anteriorly to the glottis. The use of forceps can result in mucosal trauma, bleeding, and a longer intubation time caused by the manipulation of the NTT tip. With the GlideScope video laryngoscope (GVL, Verathon), less anterior force is necessary in order to visualize the glottis. This results in less distortion of the normal airway anatomy, and should facilitate the passage of the NTT. Additionally, a decrease in the need for Magill forceps should be seen because a more anatomic alignment of the airway is preserved. A study of novice operators\(^1\) comparing the GlideScope GVL with use of a direct laryngoscope for NTT demonstrated a much shorter time to intubation in the GlideScope GVL group (45±13 vs 114±37 seconds; \(P<0.001\)), whereas a prospective observational study\(^2\) showed good times to intubation as well as glottic exposure when using the GlideScope GVL for nasotracheal intubation.

More evidence of the usefulness of the GlideScope GVL for nasotracheal intubation was provided by a prospective randomized clinical trial...
The study found that using the GlideScope GVL for nasotracheal intubation was easier, faster, demonstrated better glottic exposure, and resulted in a significantly lower incidence of moderate to severe sore throat in patients on postoperative day 1 (Table). Only 4 patients required intubation with the GlideScope GVL to prevent 1 moderate to severe sore throat. As anticipated, use of Magill forceps was common in the group undergoing DL, but not used at all in the GlideScope GVL group. Thus, the GlideScope GVL has important benefits for the anesthesiologist (eg, easier and faster), as well as the patient (eg, lower incidence of sore throat).

**Awake GlideScope GVL Use**

It may be necessary to intubate a patient with a suspected or documented difficult airway while “awake” and breathing spontaneously. Although no instrumentation or topicalization were used in the first case (documented in 1880) of awake intubation (AI), virtually any intubation technique can be used in the awake patient once adequate local, topical anesthetic is applied. Because of its tremendous versatility, fiberoptic intubation is probably the most commonly used technique for AI. However, it is not considered a rapid technique. DL is rapid, but is less likely to be successful in a difficult laryngoscopy situation. The GlideScope GVL has been shown to be rapid and to consistently improve the glottic view when the Macintosh blade provides a suboptimal view. With its rapid set-up, the GlideScope is an excellent back-up plan in the setting of unexpected difficult laryngoscopy.

**Table. Time to Intubation With the GlideScope GVL versus Direct Laryngoscope for Nasotracheal Intubation**

<table>
<thead>
<tr>
<th></th>
<th>Direct Laryngoscope (n=35)</th>
<th>GVL (n=34)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to intubation, seconds, median (interquartile range)</td>
<td>66.7 (53.8-89.9)</td>
<td>43.5 (39.8-67.3)</td>
<td>0.002</td>
</tr>
<tr>
<td>Ease of intubation VAS, mm, median (interquartile range) 0, easy to 100, difficult</td>
<td>20 (10-32)</td>
<td>10 (5.5-18)</td>
<td>0.004</td>
</tr>
<tr>
<td>Moderate or severe sore throat, n (%)</td>
<td>12 (34%)</td>
<td>3 (9%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.02</td>
</tr>
<tr>
<td>Magill forceps used, n (%)</td>
<td>17 (49%)</td>
<td>0</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

<sup>a</sup> For every 4 patients who were nasotracheally intubated with GVL, a moderate or severe sore throat was prevented.

GVL, GlideScope video laryngoscope; VAS, visual analog scale
Several authors have described excellent results performing AIs using the GlideScope GVL\textsuperscript{7-9} and our experience has been similarly favorable as it is easy, straightforward, and significantly faster than fiberoptic intubation. It also has the advantage of being less susceptible to secretions and/or damage. Additionally, the GlideScope GVL has been used as an adjunct to awake fiberoptic intubation with good results.\textsuperscript{10}

Perhaps the most significant value of the GlideScope GVL for AI may be to avoid the situation entirely.\textsuperscript{11} Patients with previous failed DLs and subsequent awake fiberoptic intubation have been able to avoid a repeat AI now that the GlideScope is available. After minimal topicalization with 4 cc of nebulized 4\% lidocaine, a “quick look” with the GlideScope can be undertaken in the surgical preparation area.\textsuperscript{11} Once an excellent glottic view is confirmed, the patient can be anesthetized (with short-acting agents if appropriate) and intubated using the GlideScope. For the remaining patients for whom a good quality glottic view is not demonstrated, the operator should proceed to complete the topicalization and undertake AI.

References


VII. The Intensive Care Unit and Remote Locations Outside the Operating Room

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Video laryngoscopy (VL) offers a vast technological step forward for the airway practitioner. VL has been shown to improve glottic visualization in the vast majority of patients undergoing elective surgery and serves as a valuable adjunct to facilitate intubation in the patient with a known or suspected difficult airway.1-4 Its potential use in the remote location outside the operating room (OR) for urgent and emergent airway interventions that may take place in the intensive care unit (ICU), the emergency department, the hospital floor, or cardiac catheterization suite is far-reaching, especially in light of the fact that emergency airway management is fraught with difficulty and patient safety concerns.5-9 Video-augmented periglottic visualization allows the adaptation of VL for airway procedures well beyond tracheal intubation plus a variety of ingenious applications and uses.10,11 Verathon’s offering of both pole-mounted (GlideScope GVL, GlideScope Cobalt) and portable (GlideScope Ranger) models allow the practitioner to have access to VL technology at the bedside outside the OR and provides easy transportability (GlideScope Ranger) in hand or within an airway equipment bag or cart.

Endotracheal Tube Exchange

Endotracheal tube (ETT) exchange may be required as a result of ETT dysfunction, luminal narrowing or occlusion, or a need to change the size or entry route (oral vs nasal vs submental). The ETT exchange often is facilitated via an airway exchange catheter (AEC) to maintain continuous access to the airway during the exchange. The exchange procedure often is combined with conventional direct laryngoscopy (DL) to assist with opening the pathway to ease ETT passage. Visualization of the glottic structures of the intubated airway with DL, especially in the patient with a difficult airway, may be restricted partially or completely.
The inability to visualize the periglottic structures during the exchange may contribute to management problems if difficulty arises when advancing the ETT. This may delay the reintubation, injure airway structures, or increase the risk for airway and/or hemodynamic complications.

Advanced laryngoscopic techniques offering “around-the-corner” visualization may overcome the limited “line-of-sight” view offered by conventional laryngoscopy. VL makes it possible to transform a “blind” high-risk exchange into one with full or near-full glottic visualization. The potential advantages of continuous glottic visualization during high-risk ETT exchange are outlined in Table 1.

Despite the improved ability to visualize the glottis with VL, maintaining continuous access to the airway during the exchange remains paramount; thus, VL serves as an adjunct to the AEC, not as an alternative. ETT exchanges under clinical circumstances that prohibit the use of an AEC (eg, luminal obstruction or narrowing) may be assisted with VL. Changing a double-lumen ETT (DLT) to a single-lumen ETT (SLT) may be challenging as a result of secretions, edema, cardiopulmonary dysfunction, limited space in the oropharynx, and the need to incorporate a smaller diameter AEC. Reintubation over the smaller AEC with an SLT (>7.0 ID) under “blind” circumstances may be a difficult process.

Two recent cases at Hartford Hospital highlight the importance and advantage of glottic visualization during ETT exchange. Two patients requiring ETT exchange (DLT to SLT in the ICU, both with known

Table 1. Potential Advantages: Continuous Glottic Viewing During ETT Exchange

<table>
<thead>
<tr>
<th>Advantage</th>
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<tbody>
<tr>
<td>Pre-exchange airway evaluation to assist with management strategy</td>
</tr>
<tr>
<td>Assessment of glottic status to allow upsizing of replacement ETT</td>
</tr>
<tr>
<td>Confirmed passing of AEC into trachea (via ETT)</td>
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<tr>
<td>Confirmation of ongoing AEC positioning within trachea (during exchange)</td>
</tr>
<tr>
<td>ETT manipulation to reduce arytenoid, vocal cord, and posterior structure hang-up</td>
</tr>
<tr>
<td>Observation/confirmation of reintubation of trachea with replacement ETT</td>
</tr>
<tr>
<td>Monitoring of depth of replacement ETT during intubation and following AEC removal</td>
</tr>
<tr>
<td>Observation of passive/active regurgitation and/or aspiration during exchange</td>
</tr>
<tr>
<td>Observation/evaluation of any laryngeal-glottic intubation trauma/damage/injury</td>
</tr>
<tr>
<td>Intubation adjunct for rescue if AEC or ETT becomes displaced or reintubation fails</td>
</tr>
<tr>
<td>Teaching/educational benefit for trainees and nursing and respiratory therapy staff</td>
</tr>
</tbody>
</table>

AEC, airway exchange catheter; ETT, endotracheal tube
difficult airways) underwent VL-assisted exchange, and each suffered inadvertent removal of the AEC from the tracheal position during removal of the “old” DLT. The practitioner was able to reintubate the trachea without incident using the GlideScope Ranger’s clear visualization.

An ongoing feasibility study at Hartford Hospital suggests an improvement in patient safety during ETT exchange for the patient with a difficult airway when using VL-AEC versus DL-AEC (ie, hypoxemia reduction: 15% to 4%, bradycardia: 5% to 2% and an improved first attempt success: 78% to 93%). VL offered a full or near-full view of the periglottic anatomy in 94% of patients who had no visualization with best attempts by conventional DL. It should be noted that in approximately 5% of ICU patients, placement of a rigid video laryngoscope may be hindered by anatomic limitations, by virtue of a halo-vest apparatus, cervical spine immobility, restricted mandibular hinging motion, or limited mouth opening.

Successful use of any advanced laryngoscopy equipment, however, is still dependent on operator skill, judgment, and patient selection. Therefore, alternative airway devices and techniques should be immediately available at the bedside. The portability of the GlideScope Ranger is particularly advantageous for procedures in the remote location as it is easily transportable. The pole-mounted models (GlideScope GVL, GlideScope Cobalt) can be transported with relative ease, and offer a larger video screen for improved viewing especially in a teaching situation. Furthermore, the pole-mounted models reduce adjustments in the viewing angle and potential screen glare.

### Extubation of the Difficult Airway

Extubation of the difficult airway has been highlighted as an area of weakness in patient care. A preformulated extubation strategy for the patient with a known or suspected difficult airway should be developed in order to potentially reduce post-extubation airway management complications. An examination of the upper airway to evaluate its patency, tissue injury, edema, or ease of visualization may serve as a supplemental component of an extubation strategy. Decision making for timing tracheal extubation and whether to commit the patient to continuous airway control via a staged extubation by leaving a conduit within the tracheal post-extubation are augmented by VL. Visualization of the intubated periglottic structures with a direct laryngoscope may be limited even in the previously straightforward airway, thus VL may provide a considerable step forward in patient care.
GVL, Ranger, and Cobalt models) markedly improved the viewing of the laryngeal anatomy for patients undergoing extubation evaluation in patients with known or suspected difficult airway (N=106, Hartford Hospital database). DL offered a restricted view or no view in 96% of the patients evaluated. Conversely, VL offered a full view or near-full view (posterior two-thirds of glottis) in 94% of patients. Airway assessment is optimized by a 2-step laryngoscopy that places the VL blade anterior and posterior to the ETT to allow periglottic viewing. The GlideScope GVL and GlideScope Cobalt pole-mounted models offer recording capabilities of airway procedures for education or documentation purposes (eg, serial VL examination to assess resolution of supraglottic swelling prior to extubation). This may ease transition and improve consistency of evaluation when a number of care providers are involved over time. The ability to visually examine the upper airway allows the practitioner to develop a more comprehensive and informed extubation strategy.

Emergency Intubation in the Remote Hospital Location

Emergency airway management outside the OR may be fraught with difficulties. Ideally, improvement of the first-pass success rate with urgent and emergent tracheal intubation would be a goal of the airway management team. The emergent circumstances clearly differ from the elective forum in the OR, thus VL-assisted visualization does not necessarily equate to effortless or undemanding tracheal intubation. Secretions, blood, vomitus, facial and airway edema, cervical spine immobility, bandages and dressings, a halo-vest apparatus, or uncertain aspiration risk are but a few of the potential risk factors for airway management difficulties. Furthermore, hemodynamic aberrations, cardiopulmonary instability, and other systemic maladies add to the problems inherent in the critically ill patient.

Is VL the panacea for airway management in the remote location? An analysis of critically ill patients who underwent emergent tracheal intubation outside the OR (N=168, Hartford Hospital database) with VL showed that experienced personnel obtained either a full or near-full laryngeal view (Cooper's grades 1 and 2) in 96% of encounters. Intubation success was 98% by anesthesia staff experienced with VL. Of these 168 cases, 122 involved VL as an airway rescue device following failed attempts with other devices (DL, bougie, or laryngeal mask airway). The vast majority of these patients (94%) had a full or near-full view with VL. The remaining 46 of the 168 patients had either a known or suspected difficult airway and underwent primary VL management as the
first step toward tracheal intubation. A full or near-full periglottic view was obtained in nearly all patients (96%), with the practitioner achieving more than a 90% first-pass success rate. Of note, limitations to VL success were varied (9 cases excluded from the 168 patients) and involved operator-dependent constraints, lack of maintenance, insufficient access to GlideScope blade covers, and clinical characteristics of the patient such as limited mouth opening.

**Tips and Techniques**

For practitioners delivering emergency airway care in remote hospital locations, it is important to be prepared for the unexpected and assume the “worst-case scenario” when arriving at the bedside of a critically ill patient in need of airway management. Complete reliance on VL technology is ill-advised and short-sighted. VL is an adjunct to our airway arsenal, not a replacement. A patient’s airway that may have been deemed appropriate for an awake fiberoptic approach in the past may not be best served by now inducing, paralyzing, and looking with VL.

Practitioners who wish to side-step the basic fundamentals of airway management and the use of other accessory devices and techniques by adapting an aggressive stance with VL as their main (or only) approach, may be met with despair when “VL fails” or “does not do its job.” Even excluding inexperience as a reason for failure, most limitations and failures remain practitioner-dependent.

**Miscellaneous Applications**

The impressive panoramic glottic viewing offered by the GlideScope models lends itself to varied and innovative adaptation to patient care in the OR, the ICU, and other remote locations. The ability to assess the oral cavity, oro-hypopharyngeal region, periglottic structures, and the cricopharyngeal opening provides the practitioner a new dimension of advancing past “blind” techniques for insertion of a variety of tubes, conduits, and instruments. With extreme caution, the traumatized airway may be assessed for injury via VL. The author has used GlideScope’s GVL, Ranger and Cobalt models for a variety of miscellaneous, non-airway uses as outlined in Table 2. The ability to overcome the limitations of “blind” procedures by providing indirect visualization of the upper airway structures with the potential of improving safety and reducing patient injury, although not evidence-based, seems logical.
Conclusion

VL plays an important role in the OR for airway management. In remote locations, VL offers a varied role as an adjunct for intubation, extubation, ETT exchange, airway assessment, and to ease placement of other devices into the aerodigestive tract. Understanding the indications, proper use, and limitations of VL are paramount in optimizing its role in patient care. Additional indications and uses will accumulate as experience with this technology grows.

References


Table 2. Miscellaneous Applications of Video Laryngoscopy

<table>
<thead>
<tr>
<th>Application</th>
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<tbody>
<tr>
<td>Passage of nasogastric, orogastric, or enteral feeding tubes</td>
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<tr>
<td>Advancement of dilating bougie for esophageal procedures</td>
</tr>
<tr>
<td>Passage of a transesophageal echocardiography probe</td>
</tr>
<tr>
<td>Placement of upper gastrointestinal endoscopy equipment</td>
</tr>
<tr>
<td>Foreign body extraction (e.g., bridgework, tooth, crown, filling)</td>
</tr>
<tr>
<td>Evaluation of the oral cavity, oro- and hypopharyngeal structures for trauma, infections, healing</td>
</tr>
<tr>
<td>Visualize laryngeal function</td>
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</tbody>
</table>

Based on references 22 and 23.


Airway management in the emergency department (ED) is challenging for the emergency physician. Patients in need of intubation frequently present with medical or traumatic conditions that greatly increase the difficulty in managing the airway. Because of the precipitous development of their condition and their unplanned presentation, there usually is little time to perform a proper evaluation to determine existence of a difficult airway. The presence of a head injury or intoxicants renders some options for airway management (eg, awake flexible fiberoptic intubation) impractical or even impossible. The introduction of the GlideScope video laryngoscope (Verathon) into clinical practice has greatly increased the options for emergency airway management and is a vital piece of equipment for the emergency physician. Various configurations of the GlideScope video laryngoscope have been used in the University Medical Center’s ED for several years. What follows is a description of the clinical experience with video laryngoscope and alternative applications for its use in the center’s ED.

The GlideScope video laryngoscope has proven very useful for many types of airways often seen in the ED. Its greatest use, however, is in patients in whom it typically is difficult to obtain a “straight line of sight” to the airway. The most obvious of these is the patient with blunt trauma whose cervical spine is immobilized. The presence of a cervical collar frequently makes direct visualization of the airway difficult. The 60-degree angulation of the GlideScope blade and the presence of the micro video camera obviates the need to directly visualize the airway. One can bring a view of the airway “outside the patient” onto the monitor. This allows intubation to be easily achieved with absolutely no movement of the immobilized cervical spine (Figure 1). Likewise, in the patient with limited neck motion and mouth opening as a result of conditions, such as severe rheumatoid arthritis, the GlideScope video laryngoscope allows...
easy intubation even when direct laryngoscopy (DL) has proven difficult or impossible. At the University Medical Center’s ED, the GlideScope video laryngoscope has been used successfully for awake intubations (AIs) when there is concern about paralyzing the patient because of potential for a difficult airway. ED physicians there have found that AI with the GlideScope Ranger is better tolerated than awake DL because very little pressure is exerted on the patient’s tongue (Figure 2). Using ketamine sedation only, the GlideScope video laryngoscope can provide an excellent view of the airway and allow intubation without performing a risky rapid-sequence intubation.

**Tips and Techniques for Difficult Intubations**

In addition to using the GlideScope laryngoscope for difficult intubations, these ED physicians have found it useful for other airway-related issues in the ED, such as confirming tube placement on patients intubated in the field. On more than one occasion, patients with field nasotracheal intubations arrived in the ED with all conventional confirmatory tests positive for tracheal intubation. Equal breath sounds, excellent oxygen saturations and positive end-tidal capnometry were noted.

**Figure 1.** Intubation with a standard GlideScope video laryngoscope provides an excellent view of the airway despite strict cervical spine immobilization.
However, when the GlideScope video laryngoscope was used to confirm placement the tube was found to be supraglottic. The tip of the tube was entering the laryngeal inlet, but the cuff was sitting above the vocal cord. Deflation of the cuff and advancement of the tube under videoscopic observation easily remedied the problem.

The GlideScope video laryngoscope also can be used to perform tube exchanges on patients with air leaks secondary to a malfunctioning cuff or inappropriately sized tube. The device allows excellent observation of the tube as it is “railroaded” down the tube exchange catheter and minimizes trauma to the larynx by allowing the operator to see what is happening as the tip approaches the laryngeal inlet (Figure 3). The operator, or an assistant, then can manipulate the tube appropriately, avoiding traumatization of the arytenoids. Usually this involves retraction of the tube by a few centimeters and rotation 90 degrees counterclockwise. The GlideScope video laryngoscope also can be used in the ED to evaluate for and remove foreign bodies in the upper airway with the assistance of Magill forceps.

Occasionally, the GlideScope video laryngoscope has been used to monitor clinical progression of certain disease states. For example, when a
The patient with adult epiglottitis is intubated in the University Medical Center’s ED with the flexible fiberoptic scope, the GlideScope video laryngoscope is used afterward to document the amount of airway edema present. Photos are printed of the glottic view visualized with the GlideScope and these are then placed in the patient’s chart. This allows the intensive care unit physicians and ear, nose, and throat surgeons involved in the ongoing care of these patients to have a baseline evaluation of the airway. Repeat GlideScope VL is then performed in the intensive care unit after appropriate treatment and this has aided in the decision to safely attempt extubation (Figure 4).

References
**Figure 4.** Standard GlideScope view of the airway in a patient with acute epiglottitis.

a. In this image, taken immediately after intubation, the large edematous epiglottis can be seen blocking the laryngeal inlet.

b. In this image, taken 3 days after intubation, the epiglottis has returned to near normal size and the laryngeal inlet is easily visible.
IX. Teaching in the Simulation Laboratory and Teaching Airway Anatomy

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When fiberoptic bronchoscopy was first introduced, many clinicians found it frustrating to teach because the teacher and the student could not visualize the anatomic structures (or lack thereof) at the same time. Just as video technology has made it easier to teach and learn fiberoptic intubation, the GlideScope video laryngoscope (GVL, Verathon) will most likely make it easier to teach and learn video and direct laryngoscopy (DL) and tracheal intubation.

At the University of Chicago School of Medicine, every third-year medical student spends 2 weeks in a required Anesthesia, Perioperative Medicine and Pain Management clerkship. The students rotate in groups of 3 making it challenging to teach DL. Either one student at a time gets a chance to perform DL and intubate with the instructor looking over his or her shoulder, or an instructor will perform DL and have the students take turns one at a time looking at the laryngeal view, prolonging the time the patient is subjected to laryngoscopy.

It can be especially helpful to demonstrate a GlideScope GVL intubation to all 3 students concurrently prior to their first attempt at DL. This allows them to see proper body mechanics, as well as the anatomy of the laryngeal opening, proper intubation technique, and final location of the tube with the cuff just below the vocal cords (Figure).

The students are told that, “viewing intubation from the perspective of the GlideScope is like seeing a play from the perspective of the orchestra conductor while the view with DL is like seeing the play from the second balcony. The players are the same, but the view is significantly different.”

GlideScope GVL can help to teach anatomy, particularly the proximal esophagus and the back of the cricoid cartilage; surprisingly, many experienced residents do not realize the size of the posterior aspect of the cricoid. By understanding this, they are better able to perform the Sellick maneuver. The shared view of the video monitor also makes it possible for the instructor to comment on anatomic points of interest like an omega-shaped epiglottis, vocal cord nodules, or edematous vestibular
folds. However, it is difficult to spend more than a few seconds during the course of laryngoscopy to illustrate 1 or 2 quick points.

The GlideScope GVL is a relatively new tool for solving difficult airway problems. Although video laryngoscopes are not mentioned in the 2003 American Society of Anesthesiologists (ASA) Practice Guidelines for Management of the Difficult Airway, they do play a significant role in the management of the patient with a difficult airway. The advantages and disadvantages of the GlideScope can be well explored during a simulation of a difficult airway scenario using a high-fidelity mannequin.

**Tips and Techniques**

The GlideScope can be used during an awake intubation after proper topical anesthesia has been administered with or without sedation. In a simulation involving the nonemergent pathway where ventilation is adequate but attempts at intubation via DL have been unsuccessful, the GlideScope offers some unique advantages over other techniques:

1. The GlideScope is a rigid scope that can help open the airway, unlike fiberoptic intubation, which must rely on oral airways or external maneuvers to create an open space for the endotracheal tube.

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**Figure.** A look at the anatomic structures of the airway using video laryngoscopy.

Photo courtesy of Irene P. Osborn, MD.
2. Because the optics are an integral part of the blade, they will stay relatively anterior in the airway and will be less prone to contamination with blood or secretions in the airway, which are the Achilles heel of flexible fiberoptic and optical stylet devices.

3. The device requires minimal setup time and can be rapidly inserted and used. The operator can quickly determine if the GlideScope GVL will be helpful in securing the airway. With many other advanced airway management techniques it can take 1 or 2 minutes to determine if the technique will work prior to abandoning it and moving on.

4. Because others in the room can see the GlideScope GVL video monitor they are better able to help.

5. Because others in the room can see what the anesthesia provider can see, they often are more patient in the setting of a difficult airway than if the operator is the only one who can see or if a blind technique such as use of an intubating laryngeal mask airway is being attempted.

The one area of debate that may arise is what constitutes “multiple failed attempts” as described in the ASA’s guidelines. For example, if conventional DL has failed 3 times with different blades and head position, one may question the appropriateness of using the GlideScope GVL. Although it may be a matter of interpretation, the GlideScope GVL is significantly different than conventional DL and would be appropriate to use in this setting as long as ventilation with a facemask remains adequate.

In summary, the GlideScope GVL provides several benefits for teaching airway anatomy and airway management techniques. Its optics allow the operator to “see around the corner.” Its screen lets others see what the operator sees, often allowing for better assistance and increased patience. It can create an open space in a closed airway and it is not prone to many of the pitfalls of flexible fiberoptic and optical stylet devices. As with all good tools, it does require one to learn its proper use and understand its unique hazards. However, with appreciation of some of the distinctive points of its use and a little practice, it can produce great benefits for patients and those managing their airways.

Reference
Some of the most challenging intubations are those performed before the patient arrives at the hospital. These cases typically involve individuals who are critically ill or injured and in need of immediate airway control. With little time to prepare, prehospital intubations are performed in unusual locations with limited supplies (e.g., in the middle of a corn field, in the basement of someone's house, or in a car from which the patient has yet to be extricated). The presence of facial trauma and cervical immobilization are other common factors that increase the difficulty of intubation. Add to this the harsh reality that many paramedics perform intubations only a few times a year and the challenges to field airway management are clear. Paramedics need every bit of technology available to rapidly and successfully carry out tracheal intubations in the field. The introduction of the GlideScope Ranger (Verathon) is a technological advancement that may be able to improve the success rate for field intubations. The design of the GlideScope Ranger, with its uniquely positioned micro video camera, unparalleled anti-fog mechanism, extreme ruggedness, and ease of portability, make it the ideal instrument for carrying out these challenging procedures. With the availability of online medical assistance via a telemedicine network, the potential for an increase in success rates for field intubations becomes more likely. The following discussion describes the integration of prehospital airway management into the existing internationally recognized telemedicine program, the Arizona Telemedicine Program (ATP), based at the University of Arizona College of Medicine.

A Look at Telebation

Telemedicine can be defined as the use of telecommunications and information technology to provide medical care at a distance. \(^1\)
Telepresence, a subdivision of telemedicine, is the nonphysical presence of a health care provider during a live patient encounter at a distance. This allows for an experienced health care practitioner to assist with the medical or surgical care of a patient while not being physically present. The introduction of video laryngoscopy (VL) in the prehospital environment has prompted ATP to develop a new concept in the field of telemedicine: telebation. Telebation is the use of telecommunications to allow for the remote assistance of VL intubation. This allows a very experienced operator to supervise and assist a VL intubation being performed by a video laryngoscopist at a distance. Thus, the experience of a seasoned video laryngoscopist can be exported to an intubator, or multiple intubators, at distance.

The ATP has an extensive telecommunications infrastructure throughout the state and links multiple rural hospitals and clinics. The majority of programs with the ATP are in fact land-based at specific health care facilities. The “Tucson-ER Link” is a program within the ATP that is unique in that it uses a “mobile” telemedicine network between the Tucson Fire Department ambulances and the emergency department (ED) at the University Medical Center (Figure 1).

**Figure 1.** Telebation being performed by a Tucson Fire Department paramedic in a moving ambulance.

The paramedic intubates with the GlideScope Ranger while viewing the large computer monitor in the rear of the ambulance.
**Figure 2.** View of the control room at University Medical Center.
An emergency department staff member can observe the intubation being performed in the field and provide real-time help with the procedure.

**Figure 3.** View of the monitor in the control room at University Medical Center.
The left-hand side of the monitor shows the video feed from an overhead camera allowing the online medical personnel to visualize the procedure from the “outside.” The right-hand side of the monitor shows the video feed from the GlideScope Ranger so the online medical personnel can visualize the procedure from the “inside.”
has been able to tap into this citywide wireless telemedicine network by modifying the GlideScope Ranger with a standard RCA video output and connecting it to a compact battery-operated Wi-Fi transmitter. Each ambulance is equipped with a Wi-Fi receiver that picks up the signal from the GlideScope Ranger and then transmits it through the existing network back to the base station at University Medical Center. The range of the Wi-Fi transmitter is 500 ft, and it allows intubations performed either in the ambulance or in the field to be transmitted over the telemedicine network. In the telemetry room at the University Medical Center’s ED, the attending physician on duty can visualize the VL intubation on a large computer monitor (Figure 2). An additional video feed is provided by an overhead camera in the ambulance, allowing the attending physician to see the paramedic and the patient (Figure 3). If desired, the VL feed in the control room can be visualized in a full screen mode. The 2-way nature of the network allows the attending physician to provide verbal feedback and guidance to the paramedic, while the paramedic is able to ask questions as the procedure is taking place. To date, this system has been tested and used successfully throughout Tucson using mannequins in moving ambulances. The system presently is being prepared for application with patients. Studies will be necessary to determine if telebation improves the success rate of prehospital intubations. Combining the technical expertise of paramedics with the experience of skilled emergency medicine practitioners has the potential to greatly improve airway management practices in the field.

Reference

Notes