GlideScope Video Laryngoscopes: Case Studies in Airway Versatility

Faculty

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Introduction

The GlideScope® Video Laryngoscope (GVL®), was developed by Canadian surgeon John Pacey, MD, and became commercially available in late 2001. The device is manufactured and distributed by Verathon Medical® (Bothell, WA). This article contains a review of the GVL systems currently on the market, as well as 3 case studies describing how these instruments can be used in clinical practice.

The original GVL employed a fog-resistant monochrome camera embedded in the undersurface of a curved, high-impact plastic laryngoscope blade. Subsequent devices have incorporated a color video camera, the image from which is displayed on a dedicated liquid crystal display (LCD) monitor. This video image can be exported to a larger monitor or recording device. Illumination of the airway is provided by light-emitting diodes. The distal third of the blade angles upward approximately 60 degrees. GVLs are available in 3 sizes: small, mid-size, and large, covering infants to large-size adult patients.

There are 3 types of GVL systems: the original reusable GVL; the GVL Cobalt Stat, consisting of a flexible "video baton," which is introduced into a single-use, sterile, clear plastic handle; and the GlideScope Ranger, a small, light-weight, self-contained, battery-operated system designed for durability and portability. The Ranger system is also available as a Cobalt-style single-use device. The GVL Stat blades come in 2 sizes: intermediate and large.

Figure 1. GlideScope Video Laryngoscope

When direct laryngoscopy (DL) is performed using a conventional curved or straight blade, the laryngoscope is placed to the right of the tongue, which must be displaced and compressed. The submandibular space is further enlarged by anterior displacement of the mandible. Pressure often must be applied to the larynx to bring it into the operator's field of view. This is "line-of-sight" laryngoscopy and there must be space in the mouth to accommodate the laryngoscope, the endotracheal tube (ETT), and a line of vision.

Unlike direct laryngoscopes, the GlideScope blade is introduced into the mouth in the midline and rotated around the tongue (Figure 1). With the GVL, the camera, embedded in the blade and pointed upward, views the glottis from a sufficient distance to provide a wide visual field. Relatively little force or manipulation is required and good or excellent glottic visualization is realized in 99% of adult patients (Figure 2).[1] This is a considerable improvement over DL, through which part of the glottis is visible in approximately 90% of adult cases.[2;3]

When DL does reveal the glottis, it is in the line of sight and a stylet is not always required. With GlideScope laryngoscopy, the larynx, even when clear on the monitor, may not be in the line of sight and an appropriately shaped stylet is necessary to deliver the ETT to the larynx. This results in an interesting paradox: With DL, intubation is frequently successful even when the larynx cannot be seen; with the

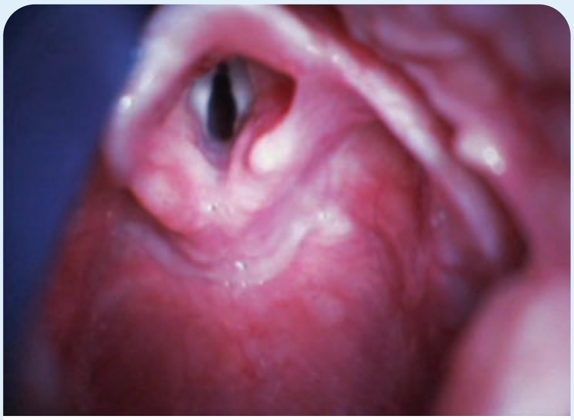

FIGURE 2. AIRWAY VIEW

Photo courtesy of Irene Osborn, MD.

GlideScope, intubation is occasionally unsuccessful even when the entire larynx can be viewed.[1] Among inexperienced users, there was a failure rate of 26 of 722 (3.7%); a Cormack-Lehane grade I view was obtained in 14 of 26 (54%) of these patients.[1] With experience, the failure rate should drop appreciably. The author has encountered only 1 failure in more than 1,800 cases and others have reported a similar experience.[4]

Another obvious contrast between DL and video laryngoscopy with a GlideScope is that to practice the former successfully demands considerable skill and practice. Visualization with a GlideScope, on the other hand, can generally be achieved with limited or no prior experience performing laryngoscopy.

Case 1: Known Difficult Direct Laryngoscopy With History of Gastroesophageal Reflux[5]

A 74-year-old man with recurrent bladder cancer presented for a transurethral bladder tumor resection. Although he denied previous difficulty with anesthetics and lacked anatomic features predictive of a difficult DL, a review of his medical records revealed otherwise. A laryngeal mask airway had been used electively on 2 occasions. Three prior anesthetics required DL and resulted in Cormack-Lehane grade III views on 2 occasions and a grade IV view on 1. Blind endotracheal intubation had been successful once, although "with difficulty"; his previous anesthetic involved the placement of an LMA ProSeal™ (PLMA, LMA North America), inserted without difficulty but complicated by regurgitation and aspiration. The PLMA was removed and DL was attempted but yielded a Cormack-Lehane grade IV view. Flexible bronchoscopic intubation and pulmonary toilet were successfully performed and the patient's arterial saturation reached a nadir of 87%.

The patient professed no knowledge of these events and, even when so advised, refused intubation with topical anesthesia and sedation. Following prophylaxis with sodium citrate, a rapid sequence induction was performed using fentanyl, propofol, and succinylcholine. Laryngoscopy with a large GVL yielded a full glottic view and intubation was accomplished in approximately 15 seconds. At the conclusion of the case, the patient was awakened and extubated over a tube exchanger. The concerns were discussed in detail and a "difficult airway letter" was sent to the patient's home, recommending the wearing of a Medic Alert bracelet.

Several months later, the patient again presented for surgery, professing no prior difficulties with anesthesia. By coincidence, this author was again assigned as the patient's anesthesiologist. The same anesthetic strategy was employed with equal success. Another letter was provided.

Case 2: Unanticipated Difficult Direct Laryngoscopy

A 78-year-old man with mild micrognathism, but no other anatomic features predicting difficult DL, presented for a nephrectomy. The patient had no history of having received general anesthesia. The patient described persistent gastroesophageal reflux despite a proton pump inhibitor, which he had taken 2 hours earlier. Sodium citrate was administered preoperatively.

A senior anesthesiology resident, anticipating no problems with DL, proceeded with a rapid sequence induction using fentanyl, propofol, and rocuronium (1 mg/kg). Direct laryngoscopy with a no. 3 Macintosh blade yielded a Cormack-Lehane grade III view. The attending anesthesiologist then attempted DL with a no. 3 Miller blade. Cricoid pressure was converted to external laryngeal pressure but the vocal cords could not be seen. A styletted ETT was advanced blindly but esophageal intubation was recognized after 2 breaths and the tube was removed.

With cricoid pressure reapplied, positive pressure ventilation was provided and a GlideScope was requested. The video laryngoscope provided a Cormack-Lehane grade I view and the patient was easily intubated. Passage of a nasogastric tube was unsuccessful despite digital manipulation and the GVL was reintroduced, revealing that the nasogastric tube persistently entered the trachea. Under guidance with the GVL, the gastric tube was manipulated and the stomach was successfully decompressed.[6] No subsequent complications occurred and the patient was provided with a difficult airway letter.

Case 3: Infectious Patient With Difficult Airway, Morbid Obesity, and Tube Exchange

During the outbreak in 2003 of Severe Acute Respiratory Syndrome (SARS), a 400-lb woman was admitted to the hospital with pulmonary infiltrates and fever. She was treated for community-acquired pneumonia, possibly SARS, and was treated in a negative pressure, isolated room.

Progressive hypoxemic and hypercapnic respiratory failure necessitated endotracheal intubation.[7] In accordance with the prevailing policies, an attending anesthesiologist was summoned.[8] The anesthesiologist donned personal protective equipment consisting of a powered air-purifying respirator, N95 mask, visor, gown, and gloves and induced unconsciousness and complete neuromuscular blockade with midazolam, propofol, and rocuronium.

Direct laryngoscopy with both Macintosh and Miller blades failed to reveal the larynx; however, endotracheal intubation was achieved blindly using a stylet. The following day, the author was summoned to the intensive care unit (ICU) because the ETT, which had been cut, was positioned just below the vocal cords. An elective ETT exchange was felt to be indicated. To minimize the risks of infection, all staff except a respiratory therapist and the author left the room.

The patient was carefully positioned in an effort to horizontally align her external auditory meatus with her sternal notch.[9] The previously described personal protective equipment and induction technique were again employed. The pharynx was suctioned with a Yankauer device and the patient was ventilated for 10 minutes at a FiO_2 of 1.0.

Before extubation, an ETVC tube exchanger was introduced into the ETT, aligning the markings of the 2 devices. A large GlideScope was introduced in the midline and a Cormack-Lehane grade I view was obtained. Ventilation was temporarily discontinued and the original ETT was removed. Under visual control, an uncut replacement ETT was passed over the tube exchanger.

It was noted that as the ETT was advanced over the ETVC, the latter tended to buckle and withdraw from the trachea, permitting the ETT to advance toward the esophagus. Under visual control, it was easy to partially withdraw the ETT, straighten the ETVC, rotate the ETT, and redirect it through the glottis. The cuff was then inflated, its position confirmed, and positive pressure ventilation was resumed with no reduction in the patient's oxygen saturation.

Discussion

These cases illustrate several important points:

- Despite careful airway evaluation, DL failure cannot always be predicted.
- Direct laryngoscopy that fails to visualize the glottis is "failed laryngoscopy," and blind intubation, even with a gum elastic bougie is variably effective.[10]
- Failed DL does not necessarily mean that intubation is difficult. Direct laryngoscopy by its very nature is dependent on achieving a line of sight. Many other intubation techniques, such as the lightwand, flexible, and rigid fiber-optic scopes, or video laryngoscopy have no such requirement.

In contrast to flexible bronchoscopic intubation, video laryngoscopy allows visualized ETT insertion and advancement. When performing flexible bronchoscopic-assisted intubation, the bronchoscope is introduced into the trachea and the ETT is blindly railroaded over it. *Undeniably, flexible bronchoscopic intubation is an essential skill*, but blind ETT advancement may prove challenging, stressful, and even occasionally injurious.[11,12]

Case 3 involved a morbidly obese patient in whom DL had recently failed, although "blind" intubation was successful. Cases 1 and 2 demonstrate that such blind intubation is unreliable and potentially dangerous. Intubations in which glottic visualization fails are associated with more and prolonged attempts, higher incidence of esophageal intubation, hypoxemia, hemodynamic instability, trauma, and unintended admission to the ICU.[2] Using the GlideScope, Cooper et al. found no relationship between body weight over 100 kg or body mass index greater than 40 and reduced laryngeal view.[1] But to the best of the author's knowledge, no adequately powered study has confirmed the advantage of video laryngoscopy with a GlideScope over DL in the bariatric patient.

In case 3, video laryngoscopy with a GlideScope permitted tube exchange to be visualized. A tube exchanger behaves much like a flexible bronchoscope; in this case, it enabled the identification and correction of a failing tube exchange.

Case 3 was a high-risk setting for both the patient and health care providers. SARS (perhaps no longer a concern) and other infections spread by droplets or aerosols, can put airway practitioners at considerable personal risk. During the SARS outbreak, hospitals recognized that provider safety demanded a change in practice to prevent coughing and abolish spontaneous ventilation. However, these changes potentially increased the risk of airway loss, particularly in patients with difficult airways.

At our institution and several other Toronto hospitals caring for patients with SARS, video laryngoscopy—and the GlideScope in particular—became the preferred laryngoscopic approach because of the greater probability of laryngeal exposure and the possibility of distancing the operator from the patient's airway.[13]

GlideScopes have proven useful for introducing nasogastric tubes.[1,6] The tube is often observed entering the trachea—even when it is difficult to do this deliberately—and it is relatively easy to redirect the tube toward a visible esophagus.

Recently, there have been several reports of intubations with a GlideScope complicated by right palatapharyngeal perforation.[14-17] It is believed that these events result from blind insertion of a styletted ETT through a taut tonsillar pillar while the operator is awaiting the approach of the ETT on the monitor. This complication likely will occur with other video laryngoscopes, too. It can be avoided by ensuring that the blade is placed midline, not on the right side, and that the ETT is inserted as close to the blade as possible. ETT insertion should be under direct visual guidance. In a crowded oropharynx, it might be helpful to insert the ETT before the laryngoscope blade. In any case, the ETT should be inserted under direct visual control.

Finally, early experience with GlideScopes noted 99% good to excellent glottic visualization but a rate of failed intubation of 3.7%.[1] The rate of failure clearly diminishes with practice. However, successful intubation is more likely when the operator inserts the blade in the midline, avoiding excessive depth of insertion and the use of an appropriately shaped ETT placed adjacent to the laryngoscope blade. Some practitioners advocate a 60-degree curvature, others 90 degrees; Verathon manufactures a rigid stylet that some find helpful; some clinicians routinely use a “dynamic stylet,” such as the Parker Flex-it (Parker Medical).[1,4,18,19]

Conclusions

The GlideScope is available in both reusable and single-use formats in several sizes. It enables laryngoscopy when line-of-sight viewing is difficult, and is associated with a higher rate of laryngeal exposure than can be achieved by conventional DL. The scope is fog resistant and displays its image on a high-resolution, dedicated color LCD monitor. The image can be exported to a larger monitor and/or a recording device. The GVL allows visualized control of ETT advancement toward and insertion into the trachea; the skill is easily acquired. The device is relatively robust and resistant to damage. It may prove to be useful in settings where axial alignment is problematic. It is suitable for use in the awake patient if so indicated and appears to require less force to insert, thereby reducing the stress of laryngoscopy.[20]

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