

Video laryngoscopes and video-assisted airway management

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INTRODUCTION

Difficulty with tracheal intubation, particularly in patients with an unanticipated difficult airway remains a frequent cause of anesthesia-related morbidity and mortality⁽¹⁾. While it has been emphasized that adherence to a precompiled strategy such as the ASA Difficult Airway Algorithm would likely decrease respiratory-related morbidity and mortality, this fact has also motivated the development of a variety of laryngoscope designs (Table I) as well as a number of supraglottic airway devices such as the Laryngeal Mask Airway. In particular, video-assisted airway management using various forms of video laryngoscope design has recently been employed to help ameliorate this problem. This article will briefly review the major video laryngoscopic techniques that are available to anesthesiologists today, with a special emphasis on the GlideScope Video Laryngoscope (GLV).

WEISS VIDEO ASSISTED LARYNGOSCOPE

Weiss et al.⁽²⁾ describe the design of an angulated video-intubation laryngoscope incorporating a fiberoptic imaging bundle. In a study in children undergoing manual inline neck stabilization they noted that the technique produced laryngeal views «which were as good or better than those observed during direct laryngoscopy alone»⁽²⁾. Success was also obtained in intubating children with Morquio syndrome⁽³⁾.

VIDEO ASSISTED BULLARD LARYNGOSCOPE

Dullenkopf et al.⁽⁴⁾ reported on the design of a video-assisted Bullard laryngoscope utilizing a thin fiberoptic imaging bundle inserted into the working channel of

the Bullard laryngoscope. The eyepiece of the imaging bundle was then attached to a video-camera system. Such an arrangement allows the operator to use the eyepiece while a supervisor follows the procedure on a video monitor.

THE MACINTOSH VIDEO LARYNGOSCOPE

Kaplan et al.⁽⁵⁾ have described their experience with the MacIntosh Video Laryngoscope (Karl Storz Endoscopy Inc., Culver City, CA, USA). This system employs a standard

Table I. Some popular and specialty laryngoscopes.

«Conventional» Laryngoscopes

- MacIntosh type laryngoscopes (curved blades)
- Miller type laryngoscopes and other straight blade designs
- McCoy laryngoscope and variants (articulating tip)

Rigid fiberoptic laryngoscopes

- Bullard laryngoscope
- Upsher laryngoscope
- Wu laryngoscope (WuScope)

Video laryngoscopes (with microminiature TV camera)

- Glidescope video laryngoscope
- Storz Video Laryngoscope (Video MacIntosh System)
- Weiss video laryngoscope
- Pentax AWS video laryngoscope
- McGrath video laryngoscope

Flexible fiberoptic laryngoscopes (Bronchoscopes)

MacIntosh blade and laryngoscope handle and is designed to allow multiperson visualization of the airway by projecting an enlarged video image of the laryngeal structures onto a monitor. The authors explain the advantages of the system: «The displayed anatomy is magnified. Recognition of the anatomical structures and anomalies is easier, and manipulation of airway devices is facilitated. When assistance is required, the operator and assistant can coordinate their movements because each sees exactly the same image on the video monitor».

Kaplan et al also studied the MacIntosh Video Laryngoscope in a series of 235 patients divided into two groups: Group A (n = 217), in whom intubation was thought unlikely to be difficult, and Group B (n = 18), in whom difficulty with intubation was anticipated. All intubations but one in Group A were successful. In the second group all 18 cases were successfully intubated using the system. The authors noted that «the improved coordination afforded by an image on a video monitor seen by both the assistant providing laryngeal manipulation and the anesthesiologist handling the laryngoscope results in a significant advantage over the conventional laryngoscope technique» and that «as a consequence, the learning curve is short».

THE RES-Q-SCOPE

The Res-Q-Scope is a particularly inexpensive (well under \$1,000) video intubation device intended for use in the field. It features a 2.75" adjustable color LCD screen used to visualize the intubation as well as a channel where a standard endotracheal tube can be pre-loaded into the device. The unit is powered with a rechargeable battery, although an emergency dry cell pack is also available. Clinical experience with the device is very limited. Additional information is available at the manufacturer's Web site at www.res-q-tech-na.com.

THE GLIDESCOPE VIDEO LARYNGOSCOPE

The GlideScope® Video Laryngoscope is a novel system for tracheal intubation that utilizes a video camera embedded into a plastic laryngoscope blade. The blade is 14 mm at its maximum width, and bends 60 degrees at the mid-line. This configuration provides a view that is usually superior to that obtained with a conventional laryngoscope. The video image is displayed on a Liquid Crystal Display (LCD) monitor, and can also be recorded electronically.

Clinical experience with the GlideScope and its recent variants (Figure 1) has shown that the unit is easy to use, even in some patients who are ordinarily very diffi-

cult to intubate⁽⁶⁻⁹⁾. In fact, the principal limitation in using the GlideScope is not in getting a good view of the glottis, but rather in manipulating the endotracheal tube (ETT) through the vocal cords, since the ETT tip often tends to hit against the anterior tracheal wall. Also, using an ordinary ETT without a stylet results in a floppy ETT that is very hard to direct through the cords, and successful oral ETT placement always requires some form of stylet, such as a Mallinckrodt Satin-Slip® Intubating Stylet bent in the shape of a «hockey stick», as illustrated below (Figure 2).

While clinical experience to date using the GlideScope in anesthetized and paralyzed patients has been excellent⁽⁶⁻⁹⁾, experience in using the GlideScope in awake patients has been limited. Doyle⁽¹⁰⁾ described the use of the GlideScope in four cases of awake intubation where the airway was anesthetized with gargled and atomized 4% lidocaine, and where superior laryngeal and transtracheal blocks were not employed. Of note, The GlideScope can be particularly helpful in ensuring that topical anesthesia is sprayed directly on the vocal cords under direct vision. As with any awake intubation method, judicious sedation is usually also administered.

There are several potential advantages of using the GlideScope for awake intubation. First, the view is excellent. Second, the method appears to be less affected by the presence of secretions or blood as compared to the use of fiberoptic intubation. (It has not been my practice to administer glycopyrrolate when using the GlideScope for awake intubation, while it is when performing awake intubation using the fiberoptic bronchoscope). Third, everyone can see what is going on, while this is the case only with fiberoptic intubation carts with a video option. (This is an important point for teaching.) Fourth, with the GlideScope the whole process can be recorded electronically using a regular camcorder. Fifth, it is possible to add a spray device to the GlideScope to spray additional topical anesthesia into the glottis under direct vision. Sixth, there are no special restrictions on the type of ETT that can be placed when using the GlideScope, while this is not the case for fiberoptic methods. Seventh, the GlideScope is much more rugged than a fiberoptic bronchoscope, and is far less likely to be damaged with use. Eighth, the GlideScope is much more easily cleaned than a fiberoptic bronchoscope. Finally, while it is well known that advancing the ETT into the trachea over the fiberoptic bronchoscope often fails as a result of the ETT impinging on the arytenoid cartilages⁽¹¹⁾, this is not a problem with the GlideScope.

The GlideScope can also be used to assist in fiberoptic intubation (FOI), either for teaching purposes, or in difficult cases⁽¹²⁾. The technique is simple. Following anesthetic induction (or in an awake topicalized patient), the GlideScope



Figure 1a. The standard GlideScope.

Figure 1b. The GlideScope Ranger (top) and a portable version of the standard GlideScope (bottom).

Figure 1c. The GlideScope Cobalt, offering a disposable cover.

Figure 1d. The manufacturer's recommended stylet.



Figure 2.

is introduced in the usual manner, followed by introduction of the fiberoptic bronchoscope (FOB). While the resident manipulates the FOB into position, the supervisor monitors the GlideScope display to see where the tip of the FOB is located. (The resident looks only through the FOB and does not look at the GlideScope display.) The supervisor then provides verbal feedback to the resident as to the location of the tip of the FOB. Once the FOB has entered well into the trachea, the endotracheal tube is then passed over the FOB into the glottis. Here, use of the GlideScope can again be helpful, since should the endotracheal tube get caught on the arytenoids⁽¹¹⁾ or other laryngeal structures, it becomes evident on the GlideScope display, and appropriate corrective action (such as twisting the endotracheal tube) can easily be taken.

It should also be pointed out that under general anesthesia, the lumen of the pharynx and the larynx usually becomes smaller as a result of reduced muscle tone. Insertion

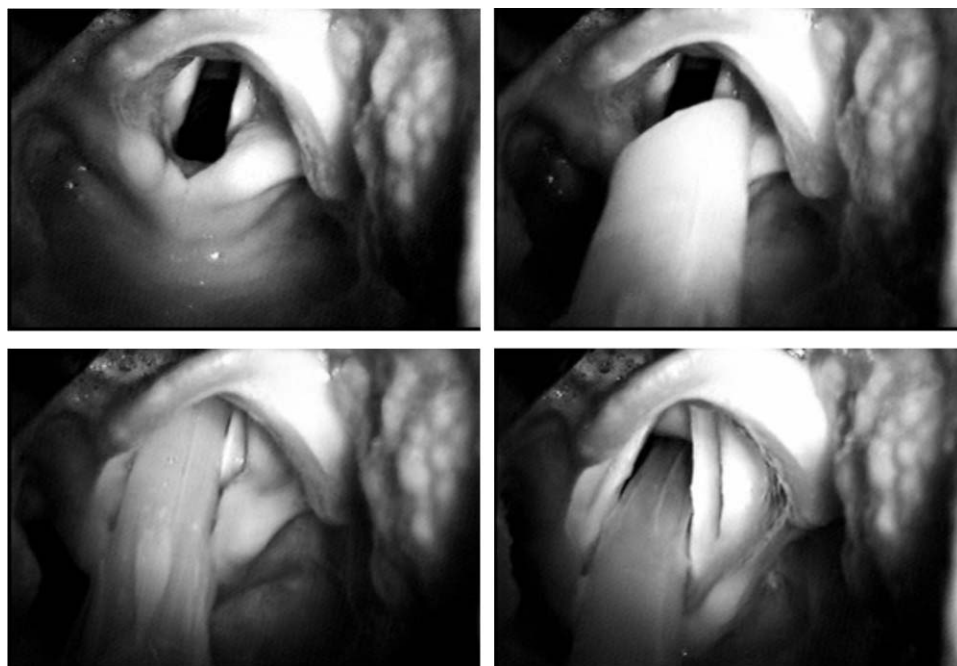


Figure 3. Close-up views from the GlideScope, as the endotracheal tube (ETT) passes through the vocal cords, from case 112 of the author's personal series. Note that during ETT placement the tube tip often tends to hit against the anterior tracheal wall. This problem is easily handled by pulling back the stylet by about 3 cm and then advancing the ETT. Sometimes it also helps to rotate the ETT 180 degrees to direct the ETT tip more posteriorly (once the stylet has been removed).

of the GlideScope lifts the tongue and the jaw to «open up» these structures and facilitates the identification of anatomical landmarks by the user of the FOB. Finally, it should be emphasized that this technique would be expected to be useful for other purposes, as in situations where FOI is difficult even for experienced operators, as may occur, for instance, in the case of airways soiled by blood.

Based on using this technique in a number of anesthetized patients to date, I have found it to be particularly valuable, especially in averting lengthy detours to peripheral structures such as the piriform fossae. It was also my experience that this technique offers a «macro view» that is helpful even when a video bronchoscope is available.

McGrath Video Laryngoscope The McGrath Video Laryngoscope^(13,14) is a video-based system for tracheal intubation that utilizes a video camera embedded into a «camera stick». A disposable transparent blade covers the camera stick, which can be easily adjusted in position using a simple ratchet mechanism. The resulting video image is displayed on a small color Liquid Crystal Display (LCD) attached to the handle of the device (Figure 4) illustrates the device.

Use of the McGrath laryngoscope is exceedingly simple. The unit is used in much the same manner as an ordinary laryngoscope with the exception that once it has been introduced into the mouth by a few centimeters, one's attention should be directed to the LCD display. I usually open the mouth using my right hand, then use the left hand to introduce the laryngoscope in the midline or slightly to the left



Figure 4. The McGrath Video Laryngoscope, featuring a position-adjustable «camera stick» covered by an easily-replaced transparent disposable sterile blade. A small LCD display located at the top of the laryngoscope handle can be adjusted to obtain the best view. The unit is powered with a single easily-replaced AA battery and features a single electronic control: an on/off switch located on the top of the unit.



Figure 5. The Pentax AWS consists of three components: an LCD display monitor, a microminiature video camera, and a disposable introducer blade, known as the «Intlock». The Intlock has channels for the video camera assembly, for the tracheal tube and for passing a suction catheter. The Intlock is designed to be positioned under the epiglottis allowing it to be elevated slightly, thus allowing insertion of the tracheal tube without the traditional requirement of aligning the oral, pharyngeal, and tracheal axis. A particularly helpful feature of the Pentax AWS is a set of cross-hairs on the color LCD display. As long as these cross-hairs are aligned to the glottic aperture, an advancing ETT will almost always go directly into the trachea. Unfortunately, this feature does not work well for reinforced ETTS.

using a gentle curving action until the glottis is identified. There is usually no need for any lifting force.

Video clips of the two cases done using the McGrath laryngoscope can be watched online as follows:

Case 1 http://www.youtube.com/watch?v=_WbJJ9XB67I

Case 2 <http://www.youtube.com/watch?v=DCnS6mBZKZ8>

In addition, I have made available a short online educational video at:

<http://video.google.com/videoplay?docid=-6196611600786989916>

PENTAX AWS

The Pentax Airway Scope (AWS) is a new video laryngoscope designed for laryngoscopy and tracheal intubation (Figure 5)⁽¹⁵⁻¹⁷⁾. It has recently become FDA approved and commercially available in the USA. Because the Pentax Airway Scope has only recently been introduced into clinical practice, there are very few studies on its use. In fact, other than a study in the emergency medicine literature⁽¹⁸⁾ there have been no randomized clinical trials to test the performance of the Pentax Airway Scope against other airway devices such as the GlideScope and the McGrath video laryngoscope.

CONCLUSION

While the use of video laryngoscopes such as the GlideScope is not yet ubiquitous, their ease of use is likely to change this situation in the next few years, and we are likely to see them used frequently in both routine cases as well as in more complex cases, such as in patients requiring awake intubation.

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