

Video Laryngoscopy in the Prehospital Setting

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EMS = emergency medical services
LCD = liquid crystal display

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Abstract

In the prehospital setting, the emergency care provider must anticipate that some patients will manifest with difficult airways. The use of video laryngoscopy to secure an airway in the prehospital setting has not been explored widely, but has the potential to be a useful tool. This article briefly reviews some of the major video laryngoscopes on the market and their usefulness in the prehospital setting. Studies and case reports indicate that the video laryngoscope is a promising device for emergency intubation, and it has been predicted that, in the future, video laryngoscopy will dominate the field of emergency airway management.

Direct laryngoscopy always should be retained as a primary skill; however, the video laryngoscope has the potential to be a good primary choice for the patient with potential cervical spine injuries or limited jaw or spine mobility, and in the difficult-to-access patient. The role of video laryngoscopes in securing an airway in head and neck trauma victims in the prehospital setting has yet to be determined, but offers interesting possibilities. Further clinical studies are necessary to evaluate its role in airway management by prehospital emergency medical services.

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Introduction

In the prehospital setting, the emergency care provider must anticipate encountering patients with difficult airways. Providers may be faced with a rapidly deteriorating airway due to severe facial trauma, neck injury, or oropharyngeal edema secondary to angioedema or anaphylaxis. Emergency medical services (EMS) providers routinely are tasked with managing the most difficult airways and prehospital patients frequently have concomitant head injuries, multi-system trauma, or presumed cervical spine injuries. A definitive airway should be secured with the safest, most efficient method that has the lowest morbidity rate. The prehospital use of video laryngoscopy has not widely been explored, but has the potential to be a useful tool. Studies and case reports show that the video laryngoscope is a promising device for emergency intubation, and it has been predicted that, in the future, video laryngoscopy will dominate the field of emergency airway management.¹ This article will review some of the major video laryngoscopes available and their usefulness in the prehospital setting.

Background

Difficult intubating conditions are encountered in approximately 7–10% of patients who require out-of-hospital, emergency, endotracheal intubation.^{2,3} Difficult intubation can be defined by the requirement of multiple attempts with a standard Macintosh (curved) laryngoscope blade, impossible visualization of glottis, or that an experienced operator states that intubation is difficult or impossible.⁴ Variations in normal anatomy, pathological conditions such as a small mouth opening, protruding upper teeth, obesity, a large tongue, and injury to the head, neck, and jaw are some factors that make intubation

Monitor + Handle	Monitor Incorporated	Preloaded ETT	Free ETT Insertion
Glidescope Ranger	McGrath	Glidescope Ranger	Pentax
	Pentax	Airtraq	McGrath
	Airtraq	Res-Q-Scope	
	Res-Q-Scope		

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Table 1—Video laryngoscopes can be classified by the way the view screen is connected to the handle (a view screen is incorporated in the handle or connected to the handle via a short cable) or the devices can be classified by those in which the endotracheal tube (ETT) is preloaded onto the device, which guides the tube to the glottic opening vs. those that require the endotracheal tubes to be inserted freely into the oral cavity.

difficult. Furthermore, intubation is more difficult when the cervical spine is immobilized. Stabilization of the cervical spine makes it more difficult to visualize the vocal cords using conventional direct laryngoscopy,^{5,6} because optimal alignment of the airway axis requires a certain amount of neck motion.⁷ Cervical collars significantly reduce the mouth opening, which also contributes to poor views on direct laryngoscopy.⁸ The rate of difficult intubation in prehospital emergency medicine varies greatly among published studies. If prehospital medical airway management is standardized and performed by trained operators, failure to intubate is rare (0.1%), and the incidence of difficult tracheal intubation is 7.4%.⁹ Conventional laryngoscopy can cause movement of the unprotected cervical spine¹⁰ and the vast majority of cervical motion during glottic visualization and intubation with a Macintosh blade is produced at the occipito-atlantal and atlanto-axial joints.¹¹ A variety of approaches and devices to secure the airway in patients with limited neck movement have been described, and the goal is to establish tracheal intubation without causing injury to the spinal cord.¹²

Video Laryngoscopes

The aim of this article is to discuss the benefits and future use of these devices in the prehospital setting, not to give a detailed description of the different video laryngoscopes (Appendix).¹ Most current systems are designed to allow multi-person visualization of the airway by projecting an enlarged video image of the laryngeal structures onto a monitor. The goal is to make the visualization and recognition of the anatomical structures and anomalies easier, and to facilitate manipulation of airway devices. These devices do so with minimal head or neck manipulation. When assistance is required, the operator and assistant can coordinate their movements because each sees exactly the same image on the video monitor.

Currently available devices can be classified in two ways. Of the five systems discussed, one (the Glidescope Ranger) has a video screen connected to the handle via a short cable. The other four systems incorporate a smaller view screen directly into/onto the laryngoscope handle. Alternately, the systems can be classified by those in which the endotracheal tube is preloaded onto the device, which then guides the tube to the glottic opening vs. those that require the endotracheal tubes to be inserted into the oral cavity, typically requiring the use of an endotracheal stylette (Table 1).

Storz DCI Video Laryngoscope

The Storz DCI video laryngoscope system is one of several airway devices that incorporates video capability into the blades.¹³ The Storz DCI integrates a fiberoptic bundle into a standard Macintosh blade and a camera housed in the laryngoscope handle produces the images. The Storz DCI Video Laryngoscope has been used successfully in difficult airways,¹⁴ bariatric,¹⁵ and pediatric surgical patients.¹⁶

Glidescope Ranger Video Laryngoscope

The GlideScope Ranger is a rugged, portable, battery-powered video laryngoscope developed for prehospital use. It consists of a plastic handle and curved laryngoscope blade with a micro-video camera embedded on the undersurface of the blade connected to a separate video monitor. Clinical experience with the standard Glidescope indicated that the unit is easy to use, even in some patients who are very difficult to intubate.¹⁷⁻²¹ A case report shows good result with the Glidescope Ranger, but most studies have been performed on the standard Glidescope; hence the benefits and complications are better documented on the standard Glidescope.¹⁷

McGrath Video Laryngoscope Series 5

The McGrath video laryngoscope houses a single AA battery to power the device and an attached color liquid crystal device (LCD) monitor. The device is inserted into the patient's oropharynx much like a traditional laryngoscope.^{22,23} The ease of use is due to its similarity to direct laryngoscopy and maintaining the visual field of the device and patient simultaneously.¹ Based upon intubation success rates and the ability to rapidly secure the airway, the McGrath video laryngoscope is an effective aid to airway management in patients with normal airways.²²

Pentax Airway Scope, AWS-S100

Airway Scope is a video laryngoscope with an ergonomically designed handle that encompasses a LCD color screen. Given its design, a Miller or straight blade approach must be used for optimal intubations.²⁴⁻²⁶ Given the quality of construction and superb optic technology, the Airway Scope has the potential for prehospital use.¹

Airtraq Optical Laryngoscope

The Airtraq optical laryngoscope is a completely disposable, single use laryngoscope utilizing mirrors and lenses to visualize the glottic opening through a curved optical chan-

nel that mimics the anatomical airway. It is an inexpensive and lightweight device.²⁷⁻³⁵ Suzuki *et al* state that the Airtraq may be a superior device for use by personnel who are infrequently required to perform tracheal intubation.³⁶

Res-Q-Scope

No publications regarding the Res-Q-Scope were found.

Use of Video Laryngoscope

Current evidence does not support the ability to confidently predict a difficult intubation. Therefore, it is imperative that devices and techniques will facilitate intubation when such difficulties are encountered.³⁷ With their low weight, high-resolution screen, and compact size, portable video laryngoscopes have the potential of being useful devices for managing difficult airways. Their use also may be beneficial in settings with limited access to the patient's head, such as during extrication or in air-medical settings when the intubator may be sitting adjacent to the patient instead of being in-line with the patient's head. Video laryngoscopes are promising devices for difficult management of the airway, including for patients with cervical spine pathology,^{38,39} and have been suggested in recent guidelines for the management of difficult airways.⁴⁰ One study indicated that with manual in-line stabilization, the Glidescope provided a better glottic view compared to direct laryngoscopy, but the cervical spine movement was similar with the two techniques.⁴¹ In other studies, the Airway Scope and Glidescope caused less cervical spine movement during intubation,⁴² but use of the Glidescope took longer than standard direct laryngoscopy.^{43,44} Compared with the Macintosh laryngoscope blade, the Airway Scope produced less movement of the upper C-spine in patients with a normal C-spine.^{45,46} The use of the Airtraq laryngoscope reduced the duration of intubation attempts and the need for additional maneuvers compared to the use of the traditional Macintosh laryngoscopy in patients with cervical spine stabilization devices in place.⁴⁷⁻⁴⁹ Two case reports have suggested that video laryngoscopy can be useful when managing a patient with cervical immobilization in the prehospital setting.^{17,50}

Because good visualization of the glottis during intubation directly impacts safety, efficiency, and morbidity,⁵¹ it is important to have high-quality equipment for difficult airway situations. Rai and colleagues concluded that the video laryngoscope is an effective device for tracheal intubation, and that it provides an improved view of the larynx compared to that acquired using traditional laryngeal blades⁵² even in difficult intubations.^{39,59} Cooper *et al* found that Glidescope laryngoscopy consistently yielded a similar or superior glottic view compared with direct laryngoscopy despite the limited or lack of prior experience with the device. Successful intubation generally was achieved even when direct laryngoscopy was predicted to be moderately or considerably difficult.^{21,54} The Glidescope rapidly provided an excellent view of the vocal cords and the tube was easily visualized passing through the vocal cords on the screen.⁵⁵ The Airway Scope also provides a better laryngeal view than does direct laryngoscopy using the Macintosh laryngoscope blade, and facilitates easier intubation in a higher proportion of patients.²⁵

In failed tracheal intubations using a conventional Macintosh laryngoscope blade, tracheal intubation was accomplished swiftly and easily using the McGrath video laryngoscope.²³ The Airway Scope facilitated easy tracheal intubations in patients for whom laryngoscopy using a Macintosh blade failed.⁵⁶ The Airway Scope is useful for beginners as it facilitates quicker and easier tracheal intubation than generally is possible using direct laryngoscopy with the Macintosh laryngoscope blade.^{57,58} Lim and colleagues showed no higher intubation success rate with the Glidescope than with a direct laryngoscopy in a simulator. However, anesthesiologists found it easier to intubate using a Glidescope compared to a Macintosh laryngoscope blade.⁵⁹ On the other hand, multiple case reports noted increased intubation success rate using Glidescope in simulated airway situations⁵⁴ and for patients with difficult airways.^{18,60,61} The Glidescope was handled easily not only by experienced anesthesiologists, but also by novice personnel (anesthesia interns and residents in training).⁶² In a simulated difficult laryngoscopy scenarios, the use of the Airtraq was more successful in achieving tracheal intubation, required less time to intubate successfully, caused less dental trauma, and was considered by the anesthesiologists to be easier to use than direct laryngoscopy.³¹

Intubation using the Glidescope caused mild hemodynamic response⁷ with in-line cervical immobilization, while another study indicated that the hemodynamic responses to orotracheal intubation using the Glidescope do not differ from the use of direct Macintosh laryngoscopy.⁶³ However, tracheal intubation with the Airtraq caused fewer alterations in blood pressure and heart rate than occurred during direct laryngoscopy.³¹

There are some reported injuries related to the use of Glidescope laryngoscopy. One aspect of the Glidescope that differs from the use of a conventional laryngoscope is that after the device is placed in the oropharynx and the laryngeal video view is obtained, most operators do not, or cannot easily visualize the endotracheal tube as it enters the mouth and is positioned within the hypopharynx before appearing on the video screen. This "blind" introduction might lead to injuries to oropharyngeal structures.⁶⁴⁻⁶⁸ Direct visualization of the endotracheal tube, as it is inserted into the mouth along the curvature of the Glidescope blade most likely would prevent these injuries.

Video laryngoscopy has obvious benefits by allowing multiple caregivers to visualize the intubation and confirm tube placement, and thereby, contribute to an enhanced teaching/learning experience. Difficulty viewing the airway using a conventional laryngoscopy also leads to ineffective teaching, as an observer must lean over the shoulder of the operator in order to catch a glimpse of the important structures and relationships. Another advantage is that the operator is not required to be "in-line" with the patient. Therefore, its use will be applicable for in-flight intubations and in other places with limited space.⁶⁹

Video laryngoscopy also has been shown to be useful for morbidly obese patients. It improves the visualization of the larynx, and thereby, facilitates intubation.^{27,70} The Glidescope provided a good view of glottic opening in morbidly obese patients.⁶⁰ The video laryngoscope also has been used successfully in the management of difficult airways in pediatric and neonatal patients.^{71,72}

Discussion

Most of the literature shows improvement in airway management using video laryngoscopy compared to direct laryngoscopy utilizing the Macintosh blade. As described, video laryngoscopy is helpful in performing difficult intubations, but to date, no studies have been preformed exclusively in the prehospital setting. There are few prehospital case reports demonstrating the utility of these devices.^{17,50} No single airway device offers a solution to all scenarios; however, the video laryngoscope is a useful addition to the range of difficult airway devices available to prehospital providers. The best device for the prehospital management of difficult airways still is undetermined, but a randomized, single-blinded study that compares the use, effectiveness, and efficiency of the different types of video laryngoscopes and traditional direct laryngoscopy with Macintosh laryngoscope is under-

way.⁷³ This should provide guidance toward the selection of a video laryngoscope for prehospital difficult airway management.

Conclusions

Direct laryngoscopy always should be retained as a primary skill; however, the video laryngoscope has the potential to be a good primary choice for the patient with potential cervical spine injury, limited jaw or spine mobility, or who is difficult to access. It also will become a rescue airway device for intubating patients with the unanticipated difficult airway. The role of video laryngoscopes in securing an airway for patients with head and neck trauma in the prehospital setting still is to be determined, but offers interesting possibilities. Further clinical studies are necessary to evaluate the use of video laryngoscopy in airway management by prehospital EMS providers.

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Appendix—Corporate contacts

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McGrath Video Laryngoscope

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Pentax Airway Scope

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Airtraq Optical Laryngoscope

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Res-Q-Scope

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