Video laryngoscopy: the past, present and future

Laryngoscopy has come a long way since the advent of the first laryngoscope some 120 years ago. From the initial direct techniques, laryngoscopy advanced through an era of flexible fiber-optic video laryngoscopes, followed by the more highly developed transition scopes, before the arrival at the end of 2000 of the first commercially available true video laryngoscope – GlideScope® – offering camera-on-blade technology. The World Airway Management Meeting (WAMM), held on the 14th November 2015 in Dublin, Ireland, saw Verathon host the GlideScope Symposium. Chaired by Dr I Ahmad, Consultant Anesthetist at Guy’s and St Thomas’ NHS Foundation Trust, the event provided the opportunity to learn more about the advent and benefits of the video laryngoscope as Dr J Pacey, the inventor of the GlideScope, and Dr S Radhakrishna, discussed the history of the technique and the current evidence base for its use. Consultant Anesthetist Dr C Frerk from Northampton General Hospital, who introduced the new DAS intubation guidelines for management of unanticipated difficult intubation in adults at WAMM, was also present to answer questions about the recommendations.

History of video laryngoscopy and invention of GlideScope

Airway video goes back quite a long way, beginning with the flexible fiber-optic video laryngoscopes introduced at the end of the last century. These first generation instruments enabled images to be viewed via a video camera, usually attached by a C-Clamp mount. However, the image quality was not always satisfactory, and this could lead to difficulties, particularly in the hands of less experienced operators. The Bullard scope, a 90° rigid fiber-optic laryngoscope, was probably the most successful video laryngoscope of this era, but alternatives included the WuScope and the UpsherScope. A second generation of more highly developed scopes – the transition scopes – followed, among them the Karl Storz series using fiber-optic image transfer and a direct style blade, and Airtraq®, with its optical mirror image transfer. Marcus Weiss, one of the pioneers of combined technology devices, also produced some excellent work using a flexible fiber-optic scope with a video channel. Finally, the true video laryngoscope using camera-on-blade technology arrived. GlideScope was the world’s first commercially available true video laryngoscope, but others eventually followed, including McGrath®, Pentax-AWS® and the Storz VMAC®. This seminal change in video laryngoscopy offers several benefits; it is more robust, usually generates a better image, and the video signal can be handled in a variety of ways.
A natural progression
The invention of the GlideScope came about by serendipity. As a vascular surgeon, I had been involved in the development of a video retractor for surgery and, after witnessing two anesthetists struggle with a difficult intubation for 28 minutes, I had the idea that this technology could be applied to laryngoscopy too. The video retractor was already established as a good tool for surgery, providing excellent, reliable images, and it was a natural progression to adapt this for use in anesthesia.

The initial prototype was based on a 45° arthroscope, which was fine but a bit bulky, and then the first true video laryngoscope was created in 1999 by attaching a video camera to a single-use blade. This was further developed, and eventually marketed as the GlideScope. The early version of GlideScope offered a reliable, black and white image, using a heated lens to prevent fogging. People loved it – the success rate for viewing the airway was very high, probably in excess of 99% – and began to buy it. A proliferation of different designs ensued, including the Ranger video laryngoscope developed for the US Air Force, which was soon also in use by the US Army in Iraq and Afghanistan, and pediatric scopes.

The success of the GlideScope can be attributed to a number of factors, including:

• Simplicity – straightforward, one-button operation
• 60° angle – giving a 99.9% Cormack-Lehane grade 1-2 view
• Heated lens – guaranteeing an immediate view
• Mobility – easy to move, yet clearly visible in the operating or emergency room

A decade of evolution
Over the past 10 years, there has been an explosion of video devices: highly angled devices such as the GlideScope, McGrath Series 5 and Pentax-AWS devices; highly angled channelled devices, for example King Vision®; direct viewing video laryngoscope devices; single use sheath devices; and single use disposable camera devices. Most recently, Verathon has introduced the GlideScope Titanium series and, as technology continues to advance, more developments are likely to follow.

The current evidence base for video laryngoscopy

Necessity is said to be the mother of invention. In 1888, Frederick III of Germany was suffering from terminal cancer of the larynx and required a tracheostomy. When, eventually, a surgeon agreed to carry out the procedure, there were complications resulting in infection. Frederick developed an abscess in the neck, and steadily declined until his death a few months later. This incident inspired Alfred Kirstein to develop the first laryngoscope in 1895. Since then, the laryngoscope has steadily evolved. However, people are now so used to the Macintosh blade, introduced in 1943, that the question “Do we really need a video laryngoscope at all?” is often asked.

Focusing on speed
A number of papers have been published reviewing the evidence. In 2010, Niforopoulou et al1 reviewed the existing literature regarding a range of video laryngoscopes, concluding that “So far, there is inconclusive evidence indicating that video laryngoscopy should replace direct laryngoscopy in patients with normal or difficult airways.” All the available evidence tended to lean towards the use of direct laryngoscopy, but this was largely due to the way the studies were designed, mainly focusing on the speed of intubation. A panel of experts, for example senior consultants, were asked to intubate patients using both direct and video laryngoscopy, and the length of time each procedure took was recorded. However, expertise in standard direct laryngoscopy does not automatically translate to proficiency in video laryngoscopy; additional training and experience is necessary2. In the studies reviewed, the consultants involved were experts in direct laryngoscopy but inexperienced in video laryngoscopy. Not surprisingly, as the comparative studies focused entirely on the speed of intubation, the results favored the direct procedure.
A natural progression
Another important paper was the systematic review of the role of video laryngoscopy in successful orotracheal intubation by Healy et al, which evaluated 77 recent human studies comparing glottis views with video and direct laryngoscopy, normal and difficult intubations, and intubations with video laryngoscopy and direct laryngoscopy in previous known difficult intubations. This evaluation was not based on speed of intubation and, as a result, the authors concluded that “In patients at higher risk of difficult laryngoscopy, we recommend the use of Airtraq, CTrach, GlideScope, Pentax-AWS and V-MAC to achieve successful intubation.” In addition, the authors stated that “In difficult direct laryngoscopy (C&L ≥ 3) we cautiously recommend the use of the Airtraq, Bonfils, Bullard, CTrach, GlideScope, and Pentax-AWS, by an operator with reasonable prior experience, to achieve successful intubation when used in accordance with the ASA practise guidelines for management of the difficult airway.” They also noted that “There is additional evidence to support the use of the Airtraq, Bonfils, CTrach, GlideScope, McGrath, and Pentax-AWS following failed intubation via direct laryngoscopy to achieve successful intubation.”

A good alternative to direct laryngoscopy
Su et al evaluated 110 randomized controlled trials comparing direct with video laryngoscopes in both mannequin- and patient-based studies, as well as different video laryngoscopes, posing the questions:

• Is video laryngoscopy better than Macintosh?
• Which is quicker to intubate with?
• Which gives the better view?
• Which is better in a difficult airway scenario?

The authors concluded that video laryngoscopes are a good alternative to direct laryngoscopy. It is marginally quicker to intubate with direct laryngoscopy when intubation is easy, although the difference in speed is not significant, but video laryngoscopy is faster when intubation is difficult. The best view is always obtained using a video laryngoscope.

Benefits of video laryngoscopy
Video laryngoscopes offer a number of advantages:

• An increased viewing angle, from 15 to 60 degrees
• Better image quality
• Can overcome the difficulties of Cormack-Lehane grade 3 and 4 views
• Help teaching and research
• Allow documentation of images for clinical review
• Can be used for awake laryngoscopy after anesthetizing the airway

In addition, video scopes can be useful in ENT surgery, helping the insertion of orogastric feeding tubes and biopsies performed in the laryngeal area. They have also been shown to be effective in the intubation of trapped casualties, for example, car accident victims.

Important considerations
While the majority of direct laryngoscopy tracheal intubations are performed without a stylet, the use of a stylet is recommended with video laryngoscopy, a decision that is influenced by the blade geometry. While many patients with normal airways can be successfully intubated using standard video laryngoscope blades without a stylet, for blades with a large curvature, the use of a stylet is beneficial. Hemodynamic stability is another important consideration, and has been shown to be similar whether direct or video laryngoscopy procedures are used for intubation. Above all, it is essential to remember that, just because video laryngoscopy is available, it is not necessarily the method of choice. There will be situations where video laryngoscopy cannot be used, for example in very bright light where it may not be possible to see the image clearly, and the technique may not be appropriate for every patient. Each patient should be carefully evaluated before deciding whether to use direct or indirect laryngoscopy.
Summary

With the birth of the video laryngoscope, it is possible that, over time, the intubating laryngeal mask airway (ILMA), CTrach and direct laryngoscope will fade away, and fiber-optic scopes may be replaced by video scopes in the future. As the Cormack-Lehane grading system is of no use with video laryngoscopy, a replacement system will need to be developed. Moving forwards, in November 2015, the Difficult Airway Society, DAS, issued new intubation guidelines – *Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults* – with a subtle change to the wording of Plan A. Whereas previously direct laryngoscopy was specified, the guidelines now simply state laryngoscopy. This allows anesthetists to make video laryngoscopy the first choice method for intubation in appropriate cases. Quite simply, video laryngoscopes have arrived.

References


