

What's new in your bag of airway toys?

Airway devices have always been on the forefront of anaesthesia equipment in terms of the variety and speed of development. Below is a review of the latest airway equipment divided into the common categories but not all are currently available locally as they may not have been registered with the Health Sciences Authority of Singapore.

Laryngoscopes

There has been a deluge of video laryngoscopes (VLs) ever since their arrival in the early 2000s.

Broadly speaking, VLs can be divided simply into two main categories: those with standalone monitors, which are larger in size and better in resolution versus those with integrated screens, which by default are smaller in size and lower in resolution.

Among the first on the market, Verathon and Karl Storz have established themselves as the two main players with their Glidescope and C-Mac models and continue to be the VLs of choice in most of the hospitals here, predominantly in the former category. But other brands have slowly but surely made their entry even though they remain as alternatives rather than as mainstays and they predominate in the latter category, which is getting to be a crowded field. These include the McGrath, King Vision, Pentax, APA, CoPilot and iView. There has also been an influx of China-branded VLs recently including the UEScope, Hugemed, Besdata and VDOScope. Some (C-Mac, Glidescope, Hugemed and Besdata) have both standalone monitors or integrated screens, the CoPilot has a standalone monitor only and the rest (McGrath, King Vision, Pentax, APA, iView, UEScope and VDOScope) have integrated screens only.

Another way to classify VLs is based on their blades.

All the VLs either come only in disposable blades (McGrath, King Vision, Pentax, APA, CoPilot and iView) or have the option of disposable blades in addition to reusable blades (C-Mac, Glidescope and all the China-branded VLs). Most VLs have Macintosh and angulated blades (C-Mac, Glidescope, McGrath, APA and Besdata) but some have only angulated blades (King Vision, Pentax and CoPilot) while others have only Macintosh blades (iView, UEScope, Hugemed and VDOScope). Among those VLs with angulated blades, most have channelled versions for ease of guiding the tube to the glottis (King Vision, Pentax and APA) while the CoPilot has a separate channel for bougie use instead. Several VLs have Miller blades for paediatric intubation (C-Mac, Glidescope, APA, UEScope, Hugemed, Besdata and VDOScope) while the rest have non-Miller blades for paediatric patients (McGrath, King Vision and Pentax) except for the CoPilot. Some have specialized blades for instance the APA Oxyblades, which allow for continuous oxygenation or the capability of the VDOScope to mimic the polio blade.

There are VLs which try to distinguish itself from others with unique features like total disposability including the screen (iView akin to the older Airtraq, which is technically not considered a VL but strictly an optical laryngoscope like the obsolete Truview hence they are not included in this review), Wifi (UEScope and VDOScope) or inbuilt video recording capability (C-Mac, Glidescope, UEScope, Hugemed and Besdata).



Figure 1

VLs: a- C-Mac b- Glidescope Titanium c- Besdata d- CoPilot e- McGrath f- King Vision channelled aBlade g- APA Oxy blade h- Pentax i- iView j- UEScope k- Hugemed l- VDOScope

Stylets

Stylets have evolved from “analogue” fiberoptic versions like the Bonfils, Levitan and Shikani to the current generation of “digital” video types for instance the Karl Storz Video Stylet, ProVu Video Stylet and Clarus Video Stylet.

Among the newer ones, some (Karl Storz and ProVu) have also incorporated the ability to manipulate their distal tips akin to bronchoscopes to become a hybrid between traditional rigid stylets and flexible bronchoscopes.

As an added feature, most of the China-branded VLs also come with accompanying video stylets. Stylets are usually reusable but a couple have developed disposable versions such as Hugemed whereby the metal stylet is single-use while the handle is reusable compared to Besdata whereby the entire stylet and handle are single-use.

Visualization options vary between models. The Clarus Video Stylet has an integrated screen while the Hugemed has a detachable screen. The Karl Storz and Besdata can be connected either to the standalone monitor or a detachable screen. The ProVu has the nifty option of a wrist-band screen in addition to a standalone monitor.

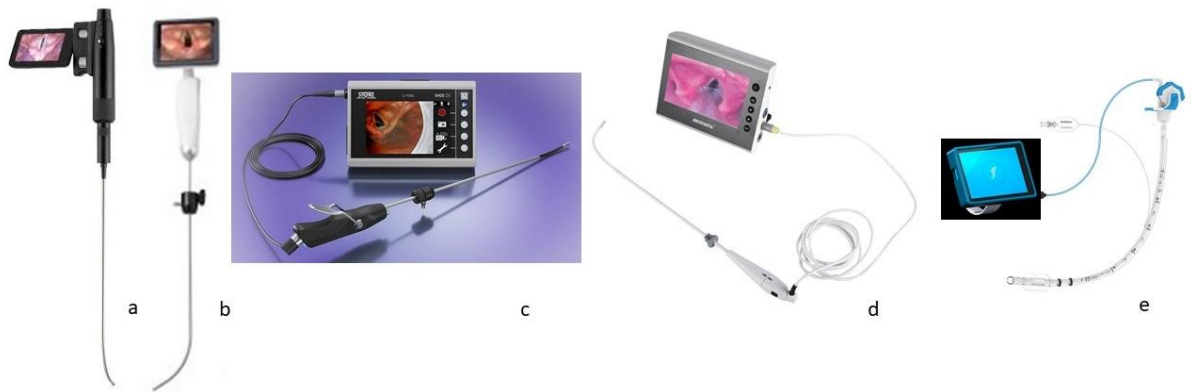


Figure 3

Video stylets: a- Clarus b- HugelMed c- Karl Storz d- Besdata e- ProVu

Supraglottic airways (SGAs)

SGAs started with the Laryngeal Mask Airway (LMA) by Professor Archie Brain in the late 1980s but they have since ballooned. The first-generation devices with just a ventilation airway tube were improved to the second-generation devices with additional gastric access for aspiration protection.

Reinforced SGAs with flexible ventilation tubes for ear, nose and throat surgeries remain relegated to the first generation due to the difficulty of integrating gastric access to them and only LMA and Ambu have them in their inventory.

The latest variants incorporated a larger gastric access tube to allow the passage of oesophoscopes through it. These include the LMA Gastro and VBM Gastro-Laryngeal Tube.

But the one important evolution is the integration of video to SGAs. The prototypical one was the c-Trach LMA but it was discontinued. Subsequently in recent years, there have been attempts to revive it. This started with the Totaltrack from Medcom which was a hybrid intubation device combining a video laryngoscope with a SGA. In the past year, there have been publications^{1,2} advocating the use of visual-aided placement of SGAs to enable optimal positioning with improved oropharyngeal leak pressures and the ability to intubate through them directly without the need for a bronchoscope. The China companies have heeded this call for such “third-generation” video SGAs and two are of great interest- the Video Laryngeal Mask (VLM) from Besdata and the Safe Laryngeal Mask (SafeLM) from Magill Medical. Both approach the idea differently with the former incorporating wired video directly into the tip of the SGA while the latter adopted a modular approach with the creation of a separate screen to attach to the SGA like that of the C-Trach LMA and TotalTrack.



Figure 3

SGAs for oesophagoscopy: a- LMA Gastro b- VBM GLT

Video SGAs: c- Medcom TotalTrack d- Magill Medical SafeLM e- Besdata VLM

Endotracheal tubes (ETTs)

ETTs have been around for the longest time compared to the rest of the airway equipment. So what more is there to invent and improve?

To address the problem of ventilator-acquired pneumonia in intensive care units (ICUs), subglottic secretion drainage ETTs were developed. These specialized ETTs incorporated a separate suction channel leading to just above the cuff so that any secretions, which collect above the cuff to slip past the grooves of the inflated cuff into the lungs resulting in micro-aspirations, may be removed.

But potentially the greatest advancement in tube technology is once again the adoption of video into the tube tip for visualisation. This is no small feat due to the need for miniaturisation but it certainly offers many uses. For double-lumen tubes, this negates the need for a bronchoscope to guide placement and subsequently any adjustments in position can be done conveniently. For routine intubations, this permits direct, rapid and gold-standard confirmation of tracheal placement. For intubated patients in ICUs, this allows continuous monitoring to ensure optimal tube position, the suctioning of tracheal secretions under direct vision and even aid in percutaneous tracheostomy without the need for additional personnel to operate the bronchoscope. Currently,

there are only 2 players on the video ETT market- Ambu with their VivaSight double-lumen and single-lumen tubes and Besdata with their double-lumen tubes.



Figure 4

Single-lumen ETT: a- Ambu VivaSight-SL

Double-lumen ETTs: b- Ambu VivaSight-DL c- Besdata DLT

Bronchoscopes

There have been two major advances in bronchoscopes since they were first invented.

The first is the progression from fiberoptic technology to video using complementary metal oxide semiconductor image sensors. This means that the bronchoscopes are now more robust since there are no longer fiberoptic bundles at risk of breaking. In addition, the image quality improves and the image size increases from a circular to rectangular view.

The latest development, which is very pertinent to the current pandemic, is the creation of single-use bronchoscopes. Disposability offers the major advantage of sterility. Some may scoff at the cost and environmental impact of single-use devices but if the sterilisation process of the reusable devices and the repair cost of fixing a broken reusable endoscope are taken into account, then these issues may not necessarily put single-use endoscopes at a disadvantage.

Currently there are three main manufacturers of single-use bronchoscopes namely Ambu, Verathon and Karl Storz. Ambu is the incumbent as it launched the aScope series in 2010 and is now currently into its fourth generation while the other two companies have just only launched their first generation recently so Ambu have a long headstart and is spearheading the development of other single-use endoscopes such as their aScope RhinoLaryngo, Cysto and Duodeno. The Ambu aScope has a 60cm working length and is available in three sizes (insertion tube outer diameter/working channel inner diameter)- 3.8mm/1.2mm Slim, 5.0/2.2mm Regular and 5.8/2.8mm Large. The Glidescope BFlex has a 56.6cm working length and similarly is also available in three sizes (insertion tube outer diameter/working channel inner diameter)- 3.8/1.2mm, 5.0/2.2mm and 5.8/3.0mm. On the other hand, the Karl Storz FIVE S has a 65cm working length and is only available in one size (insertion tube outer diameter/working channel inner diameter)- 3.5/1.2mm.

The Ambu aView 2 Advance monitor is a 12.8" touchscreen display capable of a dual side-by-side view. The Glidescope Core is a touch-screen display that comes in 2 sizes- 10" (Core 10) with picture-in-picture view and 15" (Core 15) with dual side-by-side view. The C-Mac monitor is a 7" non-touchscreen display and it can only toggle between 2 video sources. All three monitors have dual connection ports for two video inputs, a HDMI out port for external video display and capable of still image and video capture.



Figure 5

Video bronchoscopes: a- Ambu aScope b- Glidescope Core c- Karl Storz FIVE-S

Summary

These are exciting times for airway equipment. Just when you think you have seen it all, there are now more than meets the eye.

The common themes are visualisation and disposability. Visualization for safe and convenient placement of the devices while disposability for patient safety to prevent cross-contamination. This is best exemplified by the humble laryngoscope, which first made a great leap forward with the invention of the VL followed shortly with single-use blades from the initial reusable blades. We are seeing the same progression for stylets, SGAs, ETTs and bronchoscopes.

Another development to watch out for is the increasing dominance of China companies in airway equipment. Their domestic market is large enough for them to have their own ecosystem without even the need for them to enter the global market but gradually we are seeing more and more of these Chinese companies making a foray into the international scene, offering products that are in no way inferior in quality and innovation to the traditional Western companies.

References

1. Van Zundert AAJ, Kumar CM, Van Zundert TCRV, Gatt SP, Pandit JJ. The case for a 3rd generation supraglottic airway device facilitating direct vision placement. *J Clin Monit Comput.* 2021 Apr;35(2):217-224.
2. Kumar CM, Van Zundert TC, Seet E, Van Zundert. Time to consider supraglottic airway device oropharyngeal leak pressure measurement more objectively. *AA. Acta Anaesthesiol Scand.* 2021 Feb;65(2):142-145.

Websites

Karl Storz: <https://www.karlstorz.com/iq/en/anesthesiology-and-emergency-medicine.htm>

Verathon: <https://www.verathon.com/>

McGrath: <https://www.medtronic.com/covidien/en-us/products/intubation/mcgrath-mac-video-laryngoscope.html>

Ambu: <https://www.ambu.com/>

Pentax: <https://www.airway-scope.com>

APA Venner: <https://www.aamhealthcare.com>

Dilon CoPilot: <https://copilotvl.com/>

iView: <https://www.intersurgical.com/>

UEScope: <https://www.uescope.com/>

HugeMed: <https://www.shenzhen-hugemed.com/>

Besdata: <https://www.besdatatech.com/>

VDOScope: <http://www.vdomedical.com/>

Clarus: <https://www.clarus-medical.com/airway/>

Provu: <https://provuvideo.com/>

VBM: <https://www.vbm-medical.com/products/airway-management/>

TotalTrack: <http://www.medcomflow.com/producto/totaltrack-vlm-video-laryngeal-mask/>

Magill Medical: <http://magillmed.com/>