



# Current Concepts In the Management of The Difficult Airway

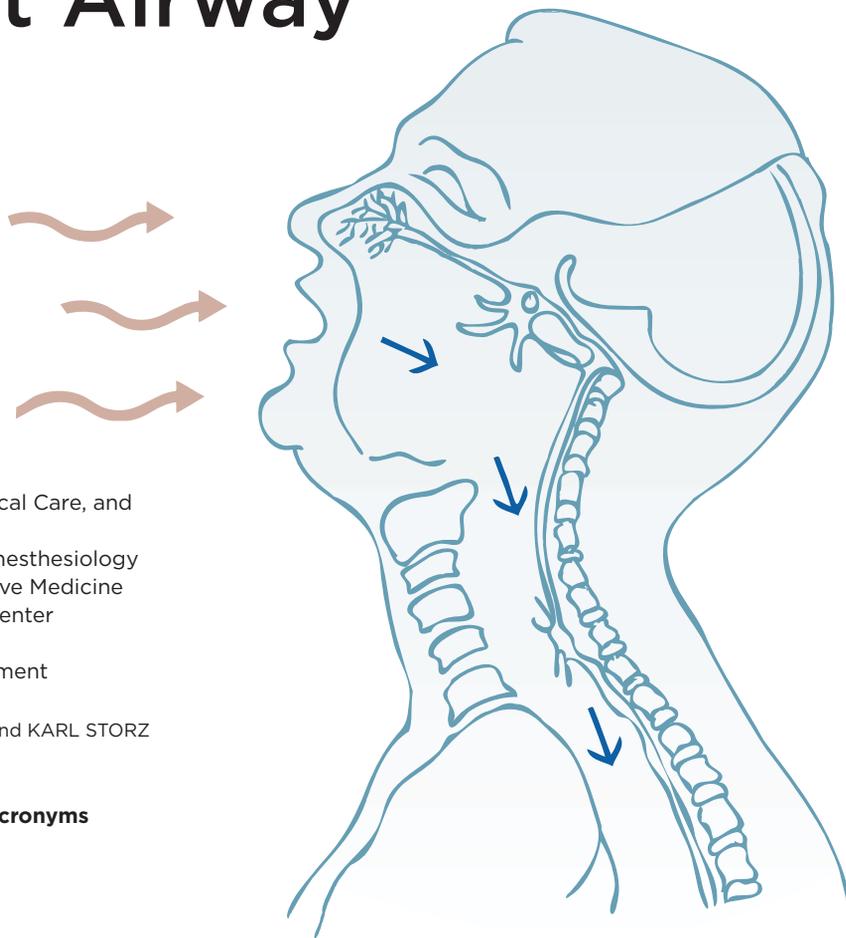
Volume 15, Number 2

## CARIN A. HAGBERG, MD, FASA

Chief Academic Officer  
Division Head, Division of Anesthesiology, Critical Care, and  
Pain Medicine  
Helen Shaffer Fly Distinguished Professor of Anesthesiology  
Department of Anesthesiology and Perioperative Medicine  
The University of Texas MD Anderson Cancer Center  
Houston, Texas  
Executive Director, Society for Airway Management

Dr. Hagberg has received grant support from Ambu and KARL STORZ Endoscopy and is an unpaid consultant to Ambu.

**Editor's note: A key of all abbreviations and acronyms appears on page 134.**



**M**anagement of the difficult airway remains one of the most relevant and challenging clinical situations encountered by anesthesia practitioners, as major adverse consequences can occur if the airway is not secured in a timely fashion. This is the second edition of “Current Concepts in the Management of the Difficult Airway” that marks the 15th anniversary of this review of airway devices and techniques that are currently available to manage both routine and difficult airways, regardless of setting.

## **Alternative Airway Devices**

A common factor preventing successful tracheal intubation is the inability to visualize the vocal cords during the performance of DL. Many devices and techniques are now available to circumvent the problems typically encountered with a difficult airway using conventional DL.

### ***Endotracheal Tubes/Guides***

Advances in ET design have been made to facilitate both passage of the ET, such as the Parker Flex-Tip (Salter Labs), and tracheal intubation in narrowed airways, such as the Tritube (Ventinova Medical BV) and the Shiley Microlaryngeal ET (Medtronic). Several ET guides have been used to aid in intubation or extubation, including both reusable/disposable and solid/low introducers, stylets, and tube exchangers (Table 1).

### ***Lighted Stylets***

Lighted stylets, when used alone, are a blind technique of intubation, as they rely on transillumination of the tissues of the anterior neck to demonstrate the location of the ET. These devices can be used with either DL or VL to allow direct visualization of the airway (Table 2).

### ***Viewing Optical Stylets***

Viewing optical stylets provide a view from the tip of the ET. Whereas the view from a VL is at the end of the laryngoscope, viewing optical stylets provide a view from the tip of the ET for steering the ET through the cords. The stylet size for this device allows it to be placed within an ET as an independent instrument, or as an adjunct to VL or DL. Additionally, some can be used to place an ET through intubating supraglottic ventilatory devices for visualization of ET placement through the SGA (Table 2). As an alternative to a viewing optical stylet placed inside the ET tip, the VivaSight-SL (ETView, Ambu) is a single-use ET with an integrated camera at the tip of the tube to provide a view for steering the ET through the cords. When in place, it provides continuous real-time monitoring of tube position (Table 2).

### ***Video Laryngoscopes***

Video-assisted techniques have become pervasive in various surgical disciplines, as well as in anesthesiology. As more VLs are introduced into clinical practice, and as airway managers become more skillful with the technique of video-assisted laryngoscopy, it could well become standard procedure for patients with known or suspected difficult airways. It also may become the standard for routine intubations as the equipment and users' skills improve and the cost of the devices decreases, with the potential for important savings in time and decreased morbidity in patients. It is beyond the scope of this review to discuss all of the laryngoscopes that have been manufactured; thus, only some of the most recently developed blades are described (Table 4).

### ***Indirect Rigid Fiber-Optic Laryngoscopes***

These laryngoscopes were designed to facilitate tracheal intubation in the same population that would be considered for flexible scope intubation (FSI), such as patients with limited mouth opening or neck movement. Relative to the flexible intubation scopes (FIS), they are more rugged in design, control soft tissue better, allow for better management of secretions, are more portable (with the exception of the new portable FIS), and are not as costly. Intubation can be performed via the nasal or oral route and can be accomplished in awake or anesthetized patients (Table 5).

### ***Supraglottic Ventilatory Devices***

The LMA (Laryngeal Mask Airway; Teleflex) is the single most important development in airway devices in the past 25 years. Since its introduction into clinical practice, it has been used in more than 300 million patients worldwide. Other supraglottic ventilatory devices are available for routine or rescue situations. The most recently developed supraglottic ventilatory devices have a gastric channel or are intended to be used as a conduit for FIS (Table 6).

## **Special Airway Techniques**

### ***Awake Intubation***

For managing patients in whom a difficult airway is suspected or anticipated, securing the airway before induction of general anesthesia adds to the safety of anesthesia and helps minimize the possibility of major complications, including hypoxic brain damage and death. To perform awake intubation, the patient must be adequately prepared for the procedure. Good topical anesthesia is essential to obtund airway reflexes and can be provided by various topical agents and administrative devices (Table 6). Other relatively new devices can be used to best position patients and maintain an open airway during awake intubation (Table 8).

Atomizing devices currently available for delivering topical anesthesia to nasal, oral, pharyngeal, laryngeal, and tracheal tissues include the DeVilbiss Model 15-RD Glass Atomizer (DeVilbiss Healthcare), the LMA MADgic (Teleflex) atomizer, and the LMA MADgic Airway (Teleflex). Although any technique of tracheal intubation can be performed under topical anesthesia, FSI is most commonly used.

### ***Flexible Scope Intubation***

FSI is a very reliable approach to difficult airway management and assessment. It has a more universal application than any other technique. It can be used orally or nasally for both upper and lower airway problems and when access to the airway is limited, as well as in patients of any age and in any position.

Technological advances—including improved optics, battery-powered light sources, better aspiration capabilities, increased angulation capabilities, and improved reprocessing procedures—have been developed. The

Airway Mobilescope (MAF; Olympus) is a portable, flexible endoscope with expanded viewing and recording capability, incorporating a monitor, LED light source, battery, and recording device in a single unit. Also available is the Ambu aScope 3 and aScope 4 Broncho, disposable, sterile, portable, flexible endoscopes with a fully functional suction/working channels (Table 3).

Rescue techniques, such as DL and placing a retrograde guidewire through the suction channel, may be performed if the glottic opening cannot be located with the scope, or if blood or secretions are present. Insufflation of oxygen or jet ventilation through the suction channel may provide oxygen throughout the procedure, and allow additional time when difficulty arises in passing the ET into the trachea.

### **Retrograde Intubation**

Retrograde intubation (Table 7) is an excellent technique for securing a difficult airway either alone or in conjunction with other airway techniques. Every anesthesia care provider should be skilled in employing this simple, straightforward technique. It is especially useful in patients with limited neck mobility that is associated with cervical spine pathology or in those who have suffered airway trauma. Cook Medical has 2 retrograde intubation sets: a 6.0 Fr for placing tubes at least 2.5 mm ID, and a 14.0 Fr for placing tubes at least 5.0 mm ID.

### **Transtacheal Jet Ventilation (TTJV) and Small-Gauge Lumen Ventilation**

TTJV is a well-accepted method for securing ventilation in rigid and interventional bronchoscopy, and there are several commercial manual jet ventilation devices available (Table 7). An MRI Conditional 3.0 Tesla manual jet ventilator (Anesthesia Associates, AincA) is also now available to enable TTJV in the MRI suite for both planned and emergency procedures (Table 7). The Ventrain (Ventiv Medical B.V.) is a single-use ventilation device specifically designed for difficult or obstructed airway situations, allowing ventilation through small-gauge lumens. Ventrain is not a traditional jet ventilator: Its ventilation is not based on a continuous high pressure to induce inspiration; instead it is based on a continuous and bidirectional gas flow, inducing both inspiration and expiration. Thus, Ventrain not only supplies oxygen during the inspiration phase, but also actively removes gas from the lungs with Expiratory Ventilation Assistance (EVA). Ventrain enables adequate ventilation through small-gauge lumen catheters, as well as in situations when the airway is obstructed.

### **Cricothyrotomy**

Cricothyrotomy (Table 9), a lifesaving procedure, is the final option for “cannot-intubate, cannot-ventilate” patients according to all airway algorithms, whether

they concern prehospital, ED, ICU, or surgical patients. In adults, needle cricothyrotomy should be performed with catheters at least 4 cm and no more than 14 cm in length. A 6.0 Fr reinforced fluorinated ethylene propylene Emergency Transtracheal Airway Catheter (Cook Medical) has been designed as a kink-resistant catheter for this purpose. Percutaneous cricothyrotomy involves using the Seldinger technique to gain access to the cricothyroid membrane. Subsequent dilation of the tract permits passage of the emergency airway catheter. Surgical cricothyrotomy is performed by making incisions through the cricothyroid membrane using a scalpel, followed by the insertion of an ET. This is the most rapid technique and should be used when equipment for the less invasive techniques is unavailable and speed is particularly important.

### **Tracheostomy**

Tracheostomy (Table 10) establishes transcutaneous access to the trachea below the level of the cricoid cartilage. Emergency tracheostomy may be necessary when acute airway loss occurs in children under the age of 10 years or those whose cricothyroid space is considered too small for cannulation, as well as in individuals whose laryngeal anatomy has been distorted by the presence of pathologic lesions or infection.

Percutaneous dilatational tracheostomy is the most commonly performed tracheostomy technique, yet it is still considered invasive and can cause trauma to the tracheal wall. Translaryngeal tracheostomy, a newer tracheostomy technique, is considered safe and cost-effective, and can be performed at the bedside. It may be beneficial in patients who are coagulopathic. Surgical tracheostomy is more invasive, and should be performed on an elective basis and in a sterile environment.

### **Conclusion**

Most airway problems can be solved with relatively simple devices and techniques, but clinical judgment born of experience is crucial to their application. As with any intubation technique, practice and routine use will improve performance and may reduce the likelihood of complications. Each airway device has unique properties that may be advantageous in certain situations, yet limiting in others. Specific airway management techniques are greatly influenced by individual disease and anatomy, and successful management may require combinations of devices and techniques.

### **Recommended Reading**

ASA Difficult Airway Algorithm. *Anesthesiology*. 2013;118(2):251-270.

Artine C, Daily W, Hagberg CA. *The Difficult Airway: A Practical Guide*. New York, NY: Oxford University Press; 2013.

Hagberg CA, ed. *Benumof's Airway Management, 4th Edition*. Philadelphia, PA: Elsevier; 2018.

**Table 1. Endotracheal Tube Guides**

Name (Manufacturer)	Description	Length, cm
<b>Aintree Intubation Catheter (Cook Medical)</b>	Polyethylene 19 Fr AEC allows passage of a FIS through its lumen. Has 2 distal side holes and is packaged with Rapi-Fit adapters. Color: light blue.	56
<b>Arndt Airway Exchange Catheter Set (Cook Medical)</b>	Polyethylene 14 Fr AEC with a tapered end, multiple side ports, packaged with a stiff wire guide, bronchoscope port, and Rapi-Fit adapters. Color: yellow.	50, 65, 78
<b>Cobra Introducer (Occam Design)</b>	15 Fr airway intubation guide with telescoping extension. Coudé tip and 3 side holes. Color: orange.	60 (73 when telescopically extended)
<b>Cobralet (Occam Design)</b>	15 Fr airway intubation guide with hollow interior channel. Color: orange.	60
<b>Cook Airway Exchange Catheter (Cook Medical)</b>	8.0, 11, 14, and 19 Fr polyethylene designs facilitate exchange of single-lumen tube or DLT of $\geq 4.0$ mm ID. The DLT versions are EF with soft tips. Colors: yellow, green; soft tip is purple.	43, 83, 100
<b>Cook Staged Extubation Set (Cook Medical)</b>	Soft-tipped marked extubation wire to maintain continuous airway access, wire holder and Tegaderm for securement, soft-tipped Reintubation Catheter, Rapi-Fit adapters to assist in oxygen delivery, if necessary. Available outside of US only.	ETs $>5.0$ mm ID
<b>CoPilot VL Rigid Intubation Stylet (Dilon Technologies)</b>	Reusable CoPilot VL intubation stylet.	ETs $\geq 6.0$ mm ID
<b>CoPilot VL Disposable Bougie (Dilon Technologies)</b>	14 Fr polyethylene single-use ET introducer with coudé tip. Color: orange.	60 (ETs $\geq 6.0$ mm)
<b>D-BLADE (KARL STORZ Endoscopy)</b>	Reusable stylet designed especially for the C-MAC reusable and single-use adult D-BLADE. Individually peel packed in boxes of 10.	31; diameter shaft: 3-mm tip: 5 mm ID (ETs $\geq 5.5$ mm)
<b>Flexible Tip Bougie (Sharn Anesthesia)</b>	Steerable ET introducer with soft, flexible, and controllable tip. Ideal when there is a great view but advancing the ET is still a problem.	65 cm, 15 Fr (ETs $\geq 7.0$ mm)
<b>Frova Intubating Introducer (Cook Medical)</b>	Polyethylene 8.0 and 14 Fr AEC with angled distal tip with 2 side ports. Has hollow lumen and is packaged with a stiffening cannula and removable Rapi-Fit adapters. 14 Fr also packaged in box of 10. Colors: 8 Fr, yellow; 14 Fr, blue.	35, 70
<b>Insight Rigid Stylet (Bell Medical)</b>	Reusable and sterilizable. Designed to work with GlideScope, C-MAC, and Insight VL.	34 cm 3.8 OD (ETs $\geq 4.5$ mm)
<b>Intros Pocket Bougie (BOMImed)</b>	Single-use 14 Fr (4.7 mm) malleable ET introducer made from special blend of Teflon. Packaged in box of 10.	60 (ETs $\geq 5.0$ mm)
<b>METTS Muallem ET Tube Stylet (VBM)</b>	Single-use 8.0, 12, 14 Fr stylet; malleable, but with soft and atraumatic coudé tip. Color: green.	40, 65
<b>OptiShape (Teleflex)</b>	Reusable, sterilizable, semirigid stylet with optimal shape memory for indirect intubation procedures.	4 sizes (ETs 2.5-3.5, 4.0-5.5, 5.0-6.5, and 7.0-9.0 mm)
<b>Pocket Introducer (VBM)</b>	Single-use 15 Fr Introducer with coudé tip. Color: blue.	65
<b>Portex Tracheal Tube Introducer (Smiths Medical)</b>	15 Fr ET introducer made from a woven polyester base, with a coudé tip (angled 35 degrees at its distal end). Also known as the gum elastic bougie. Color: golden brown.	60

Clinical Applications	Special Features
Exchange of SGAs for ETs $\geq 7.0$ mm using a FIS. Its hollow lumen allows insertion of a FIS directly through the catheter so that the airway can be indirectly visualized.	Large lumen (4.7 mm) allows passage of a FIS. Rapi-Fit adapters allow both jet ventilation and ventilation with 15-mm adapter (anesthesia circuit or Ambu bag). Single use.
Exchange of LMAs and ETs using a FIS.	Tapered end and multiple side ports. Rapi-Fit adapters allow both jet ventilation and ventilation with 15-mm adapter (anesthesia circuit or Ambu bag). Single use.
Facilitates tracheal intubation, especially in situations of difficult airway anatomy. Facilitates both DL and VL. Works as a traditional bougie, then additionally extendable while in use, when desired.	Telescoping segment to enhance glottis entry. Malleable, reversible, and controllable from middle or either end.
Facilitates tracheal intubation.	Malleable, hollow interior for oxygen insufflation.
The Cook AEC is intended for uncomplicated, atraumatic, ET exchange for both single-lumen tubes and DLTs.	EF with 2 distal side holes. The soft-tip version offers a more flexible tip to help minimize tracheal trauma. Rapi-Fit adapters as above, but should be used primarily for jet ventilation because of length. Single use.
Provides a tool for a more complete extubation strategy, which should be in place for every patient.	Uses an atraumatic wire to maintain continuous airway access and a soft-tipped reintubation catheter to facilitate a successful reintubation if required and delivery of oxygen when desired.
Reusable CoPilot VL intubation stylet for use with VL to facilitate ET placement.	Reusable, easy to high level disinfect or sterilize.
Facilitates tracheal intubation. May also be used for tube exchange.	Single use.
The angle of the D-BLADE reusable stylet complements the angle of the C-MAC D-BLADE laryngoscope to help facilitate placement of an ET. The pre-shaped stylet improves maneuverability of the ET tube toward the target.	Sateen finish allows the stylet to pass more easily into ETs. Packaged ready to use; no reprocessing necessary for first use.
Useful with DL or VL, single-use Flexible Tip Bougie facilitates ET placement and is particularly helpful when advancement of the airway or a traditional bougie is difficult.	Sliding “tabs” are moved with user’s thumb to flex or retroflex the tip to maneuver around the anatomy. Phosphorous tip for improved visualization under UV illuminated laryngoscopy. Useful with DL and VL.
Facilitates tracheal intubation and allows simple ET exchange. Can also be used by placing it first in the ET, with its tip protruding, or placing it directly into the glottis and then placing the ET over it.	Can be used in pediatric population for ETs as small as 3.0 mm. Hollow lumen allows oxygenation/ventilation in all sizes. Single use.
Preformed curve matches that of Insight VL, GlideScope, and C-MAC.	Reusable, durable stainless steel; easy to clean and sterilize.
Designed to facilitate both DL and VL tracheal intubation. Unique curvature designed to follow natural path of the airway. Flexibility: Customizable coude tip angles allows for manipulation of the distal tip for anterior airways.	Self-lubricated bougie, tactiglide technology for tactile sensation, optimal curve with shape memory, balanced rigidity with soft-tissue protection, depth markings, packaged sterile.
Designed to facilitate both DL and VL tracheal intubation.	Malleable stylet with soft coude tip and graduation marks for insertion depth.
Facilitates smooth passage of ET in both routine and difficult intubations. Especially useful in combination with the variety of VLs that employ $>42$ degrees. Designed with the ideal curve to closely follow the blade shape and ensure successful passage of ET through vocal cords.	Easily adjustable to a variety of ET sizes. Suitable for use in combination with a variety of VLs that employ $>42$ degrees angle of vision.
Facilitates tracheal intubation.	Folded to only 20 cm, unfolds to 65 cm within seconds; ideal space solution for emergency bags.
Proven useful in patients with an anterior larynx (grades 2b, 3, and 4) and those with limited mouth opening. Can be used by slightly protruding through the ET, or placing directly into the glottis and then placing an ET over it.	Nondisposable and reusable. Size 5.0 Fr is single use. Has memory properties. Coude tip effectively detects “tracheal clicks” to confirm correct placement. Part of a range of introducers, stylets, and guides for adults and pediatrics. Can be reused after cold-water disinfection.

table continues on next page

**Table 1. Endotracheal Tube Guides** (continued)

Name (Manufacturer)	Description	Length, cm
<b>RPIS (Rapid Positioning intubation Stylet)</b> (Airway Management Enterprises)	Single-use flexible stylet with tip that allows 180-degree flexion and retroflexion. Tip protrudes 5 cm from the end of ET. Color: blue.	38 (ETs $\geq$ 6.0 mm)
<b>Rhinoguard</b> (Davis Medical)	ET introducer/dilator.	25.4 cm: small for ETs 3.0-4.5 mm; 35.5 cm: large for ETs 5.0-8.0 mm
<b>S-Guide</b> (VBM)	Single-use 15 Fr stylet, malleable, with atraumatic coude tip and hollow for oxygenation.	65
<b>Portex Single-Use Bougie</b> (Smiths Medical)	15 Fr, PVC ET introducer with coude tip. Has a hollow lumen that discourages reuse and is provided sterile. Color: ivory.	70
<b>VBM Introducer</b> (VBM)	Single-use 15 Fr introducer with coude tip and hollow for oxygenation. Color: orange.	65
<b>VBM Tube Exchanger</b> (VBM)	Single-use 11, 14, and 19 Fr tube exchanger that is hollow to allow oxygenation. Color: blue.	80
<b>Vie Scope</b> (Adroit Surgical)	Allows for a straight line-of-sight view with 360 degrees maximal illumination to pass a bougie between the vocal cords. Provides the ability to intubate the patient when awake in trauma situations both in the hospital and in the field. Single use.	Adult, one size fits all
<b>Voir Bougie</b> (Adroit Surgical)	Single-use 15 Fr polyethylene ET introducer with formable tip. Colored safety bands: Light blue bougie with green and red safety depth marking bands gives the user immediate depth insertion distance for rapid and safe intubation.	70 cm, 15 Fr (ETs $\geq$ 6.0 mm)

**Table 2. Stylets**

Name (Manufacturer)	Description	Size
<b>Lighted Stylets</b>		
<b>Aaron Surch-Lite</b> (Bovie Medical Industries)	10-in sterile, single-use, flexible stylet.	Adult
<b>AinCA Lighted VideoStylet</b> (Anesthesia Associates)	Easily malleable, lighted stylet with adjustable ET holder. Shapes and guides ET while forwardly illuminating passage. Completely reusable device consisting of removable handle with xenon bulb.	Adult and pediatric (ETs $\geq$ 5.0 mm) Infant (ETs $\geq$ 3.0 mm)
<b>Tube-Stat Oral Intubation Stylet</b> (Medtronic)	Similar to AinCA lighted VideoStylet.	Nasotracheal: 33-cm shaft Orotracheal: 25-cm shaft
<b>Vital Signs Light Wand Illuminating Stylet</b> (GE Healthcare)	Similar to AinCA lighted VideoStylet.	Adult

Clinical Applications	Special Features
Provides greater visibility and control of tip similar to a FIS (with 1 provider) in difficult and routine intubations with VL.	Single-use stylet with atraumatic soft tip.
Facilitates nasal intubation.	Optimized longitudinal stiffness to facilitate passage of an ET, especially in challenging nasal passages. Customized for 3.0-8.0 ETs. Optimal OD taper provides ability to utilize larger ET, if desired.
Difficult intubation. Ideal for nonchanneled VL.	Malleable stylet with soft tip and oxygenation possibility (3 in 1). Unique oxygen connector included.
Single-use product reduces risk for cross-contamination. Otherwise, same as Portex Venn Tracheal Tube Introducer.	Similar to Portex Venn Tracheal Tube Introducer, but hollow lumen allows oxygenation/ventilation. Single use.
Difficult intubation with oxygenation possibility.	Supplied with unique removable connector to allow oxygenation with 15-mm connector or jet. Graduation marks for insertion depth.
Exchange of ETs.	Similar to Muallem ET Introducer.
Trauma, routine, difficult, and awake intubations can now be accomplished with one scope anywhere.	Patented LED ring illumination located at the proximal end of a self-enclosed clear tube allows light to be transmitted through the lumen of the tube as well as the sidewall to avoid obstruction of light by secretions or blood.
Facilitates tracheal intubation and increases patient safety.	Clearly marked color bands (patent pending) permit the user to note the correct depth upon insertion to avoid lung or tracheal injury.

Clinical Applications	Special Features
Usable for routine blind intubations or additional illumination during laryngoscopy, but especially useful when FIS unavailable (eg, outside locations or ambulances), or when bronchoscopy is difficult to perform (eg, obscured airway or limited head motion allowed).	Can be used alone or with other techniques. Completely disposable. Intended for single use. Individually packaged in boxes of 3.
Same as Aaron Surch-Lite.	Can be used alone or with other techniques. Handle-mounted xenon light source is always on and keeps stylet tip cold. Uses 2 AA batteries. System is completely reusable and sterilizable.
Ideal for difficult intubations, teaching.	Minimizes neck flexion and head hyperextension in trauma cases.
Flexible lighted stylet for use with or without a laryngoscope. Especially useful in soiled or bloody airways.	Bright light provides excellent verification of ET positioning, even during difficult intubations. ET temperature will not rise above 42°C (108°F).

table continues on next page

**Table 2. Stylets** (continued)

Name (Manufacturer)	Description	Size
<b>Viewing Optical Stylets</b>		
<b>AincA VideoStylet (Anesthesia Associates)</b>	Easily malleable, video imaging stylet with built-in ET holder. Shapes and guides ET while forwardly illuminating the passage and providing full-color image. Completely reusable device consisting of removable VideoStylet and attached rechargeable LCD monitor.	Adult and pediatric (ETs $\geq 6.0$ mm)
<b>Brambrink Intubation Endoscope (KARL STORZ Endoscopy)</b>	High-resolution semirigid fiber-optic stylet with a 40-degree curved shape at distal end, 40 $\times$ magnification, fixed eyepiece, movable ET holder, and an insufflation port.	2.0 mm OD; ET must be $\geq 0.5$ mm larger to fit
<b>C-MAC Video Stylet (KARL STORZ Endoscopy)</b>	A high-resolution chip at the distal end of the endoscope. The tip can be angulated anteriorly by up to 90 degrees, which helps in the narrow conditions of the oral cavity. The patented active bend mechanism can be used with an attached ET and supports at the same time the passive return. Intuitive handling with universal C-MAC System interface for C-MAC Monitor (8403 ZXX) and C-MAC PM (8403 XD).	With ET adapter and suitable for ET $\geq 6$ mm
<b>Clarus Levitan (Clarus Medical)</b>	Portable high-resolution fiber optics enclosed in a malleable stainless steel stylet provide a view from the tip of ET. Built-in tube stop to hold ET in place with integral oxygen port for oxygen insufflation during intubation. Assist with DL/VL like regular stylet to provide an added view from the tip of the tube, or can be used independently as an easier-to-learn, less expensive alternative to FIS. Also malleable to be used through intubating supraglottic ventilatory devices. Optional adapter uses smartphones to transform optics to video.	Adult (ETs $\geq 5.5$ mm)
<b>Clarus Pocket Scope (Clarus Medical)</b>	Conveniently sized, easy-to-clean, and cost-effective (reusable) flexible stylet that has a patented, deflected, nondirectable tip. Optional adapter uses smartphones to transform optics to video. Often used to confirm placement and patency of airways.	Adult (ETs $\geq 4.0$ mm)
<b>Clarus Shikani (Clarus Medical)</b>	Viewing stylet: high-resolution, stainless steel, malleable (shapeable) fiber-optic stylet. Has adjustable tube stop and integral oxygen port for oxygen insufflation. Assist with DL/VL like regular stylet to add a view from the tip of the tube. Or used independently as an easier-to-learn, less expensive alternative to bronchoscope. Also malleable for use through intubating supraglottic ventilatory devices. Optional adapter uses smartphones to transform optics to video.	Adult (ETs $\geq 5.5$ mm) Pediatric (ETs 2.5-5.0 mm)
<b>Clarus Video Stylet 3000V (Clarus Medical)</b>	Malleable (shapeable) rigid stylet scope with attached LCD screen and adjustable curve shape provides view from end of stylet; built-in tube stop to hold ET in place with integral oxygen port for oxygen insufflation during intubation. Assist with DL/VL like regular stylet to provide view from the tip of the tube or used as independent device as an easier, less expensive alternative to FIS. Also malleable to be used through intubating supraglottic ventilatory devices.	5 mm OD; ETs $\geq 5.5$ mm
<b>GlideRite Rigid Stylet (Verathon)</b>	Reusable, sterilizable, rigid stylet specifically designed to work with GlideScope unique angle VL; provides improved maneuverability in ET placement.	Length including handle: 34.8 cm (ETs $\geq 6.0$ mm)
<b>Insight Lighted Video Stylet (Bell Medical)</b>	Malleable rigid stylet video scope with attached HD video display and adjustable curve shape provides view from end of stylet; built-in tube stop to hold ET in place with integral oxygen port for oxygen insufflation during intubation.	34 cm 3.8 OD (ETs $\geq 4.5$ mm)
<b>J-Wand (D R Burton Healthcare Products)</b>	Semirigid intubating stylet that can be utilized with both video and standard laryngoscopy equipment. Flexible angled introducer tip to facilitate ET placement. Oxygenation port built into handle enables providers to perform apneic oxygenation techniques during intubation process.	Can be used with 6.0 ETT and larger
<b>SensaScope (Acutronic Medical Systems)</b>	Hybrid S-shaped, semirigid fiber-optic intubation video stylet. Has a 3-cm steerable tip with video chip that can be flexed in sagittal plane 75 degrees in both directions with lever at proximal end of device. Has no working channel.	Adult (ETs $\geq 6.5$ mm)
<b>VivaSight-SL (ETView/Ambu)</b>	Single-use ET with an integrated camera at the tip. Image is displayed on a monitor via a cable.	ID 7.0, 7.5, and 8.0 mm

Clinical Applications	Special Features
Usable for routine intubations or video imaging during laryngoscopy, but especially useful when a FIS is unavailable (eg, outside locations or ambulances), or when bronchoscopy is difficult to perform (eg, obscured airway or limited head motion allowed).	Provides rapid learning curve due to similarity to standard ET advancement techniques, but with added benefit of an attached, clear video image of all landmarks forward of ET tip. Allows for single-handed use with imaging or used in conjunction with a laryngoscope, as desired for physical alignment. Reusable system. Sterilized by glutaraldehyde or Sterrad.
Able to elevate a large, floppy epiglottic and navigate through the oropharynx of patients with excessive pharyngeal soft tissue, midline obstruction, limited mouth opening, or fragile veneers on incisors.	Available for DCI video cameras. Compatible with standard camera coupler when used with an eyepiece adaptor (available from KARL STORZ).
Able to elevate a large, floppy epiglottis and navigate through the oropharynx of patients with excessive pharyngeal soft tissue, midline obstruction, limited mouth opening, or fragile veneers on incisors.	Fixed-shape shaft with adjustable eyepiece that allows ergonomic movement during intubation, in addition to adapter for fixation of ETs and oxygen insufflation. Portable, rugged, and better maneuverability than flexible FIS. Used with battery-powered or portable light source.
Similar to Shikani and Clarus Video Stylet Scope. Originally designed as adjunct to DL for improved first-pass success. For easy intubations, it is used as a standard stylet. Or, when faced with an unexpected grade 3 or 4 DL view, it offers additional view from “around the corner” via the tip of the tube for successful first-pass intubation. May also be used as a stand-alone device as an alternative to FIS for awake (or anesthetized). See Clarus Video Stylet 3000V.	GreenLine laryngoscope handle or a Turbo LED can be used for light sources. Otherwise, similar to Clarus Video Stylet 3000V, but requires user to cut the ET because it does not have a movable tube stop. Able to connect to an endoscopic tower monitor or a smartphone adapter to connect to a smartphone screen for video viewing. Portable and small enough to carry in airway bag/crash cart when FIS may not be readily available.
Allows for visualization during intubation through ILMA or quick confirmation of SGA, DLT, or ET placement/positioning patency. May also be used prior to extubation.	Has been modified with a patented deflected tip for a view from the end of the device. Able to connect to an endoscopic tower monitor or a smartphone adapter to connect to a smartphone screen for video viewing.
Similar to Clarus Video Stylet 3000V.	Comes in either adult or pediatric size. Light source options are light cable, Turbo LED, or GreenLine laryngoscope handle with adapter. Otherwise, similar to Levitan Viewing Stylet.
Provides view from the tip of the tube. Similar to Shikani and Levitan viewing stylets. Many use it as a stand-alone device as an alternative to a FIS for awake (or anesthetized) intubations. Provides access with limited mouth openings, anterior airways, radiation or ENT patients. Malleable stylet allows shaping to reduce cervical movement. May also be used to intubate through a supraglottic airway or checking placement of ETs or SGAs. Also can be utilized for an awake look prior to intubation. May be used with routine DL/VL intubations to limit pharyngeal trauma. The ability to have a view from the tip of the optical stylet allows navigation to the glottis without direct alignment of the airway axes.	Has the simple form of a standard stylet, plus the advantage of a fiber-optic view. Portable, rugged, and able to lift tissue. Malleability allows for more universal use in multiple techniques and various airway situations. Red LED provides transillumination. Portable and small enough to carry in airway bag/crash cart when a FIS may not be readily available.
The preformed angle of the GlideRite Rigid Stylet complements the unique angle of GlideScope VL to help facilitate placement of an ET.	Reusable, durable stainless steel; easy to clean and sterilize or high-level disinfect.
Similar to KARL STORZ, Shikani, and Clarus Video Stylet Scope. Used as a standard stylet and ideal for patients with reduced mouth opening ability.	Malleable stylet is a pioneer of semirigid tube core that returns to original shape. HD display, tube secure stop and oxygen insufflation, easy record of pictures and videos.
Can be used with both standard and VL equipment. Facilitates placement of ET, especially in the anterior airway. Ability to provide direct apneic oxygen delivery from the ET during intubation.	Flexible, angled introducer tip and stylet design that mimics modern curved-blade VL. Apneic oxygenation port built into handle. Semirigid stainless steel support within ET. Ergonomic design facilitates easy insertion and removal of the stylet. Disposable, single use.
Similar to Brambrink Intubation Endoscope.	Offers an improved view of glottis, simultaneous direct and endoscopic views, full visual control over passage of ET, and confirmation of final position. No need for extreme head extension or forced traction of laryngoscope. Can be rapidly assembled for immediate use.
Direct view during intubation; useful for verifying ET and endobronchial blocker placement and repositioning. Indicated for use during routine or difficult intubations.	Continuous visualization allows real-time observation and monitoring of ET or endobronchial blocker position throughout the procedure.

**Table 3. Flexible Intubation Scopes**

Name (Manufacturer)	Description	Size
<b>aScope 3 Large (Ambu)</b>	Single-use FIS. OD: 5.8 mm; working channel ID: 2.8 mm.	60 cm (ETs ≥7.0 mm)
<b>aScope 3 Regular (Ambu)</b>	Single-use FIS. OD: 5.0 mm; working channel ID: 2.2 mm.	60 cm (ETs ≥6.0 mm)
<b>aScope 3 Slim (Ambu)</b>	Single-use FIS. OD: 3.8 mm; working channel ID: 1.2 mm.	60 cm (ETs ≥5.0 mm)
<b>aScope 4 Broncho Large (Ambu)</b>	Single-use FIS. OD: 5.8 mm; working channel ID: 2.8 mm.	60 cm (ETs ≥7.0 mm)
<b>aScope 4 Broncho Regular (Ambu)</b>	Single-use FIS. OD: 5.0 mm; working channel ID: 2.2 mm.	60 cm (ETs ≥6.0 mm)
<b>aScope 4 Broncho Slim (Ambu)</b>	Single-use FIS. OD: 3.8 mm; working channel ID: 1.2 mm.	60 cm (ETs ≥5.0 mm)
<b>FIVE S Scope - Single-Use Flexible Intubation Video Endoscope (KARL STORZ Endoscopy)</b>	The new single-use FIVE S is compatible with the C-MAC Video Intubation Platform. Similar to the reusable FIVE Scope, the distal chip provides 300,000 pixels resolution and a wide angle of view, and its rigid sheath easily maneuvers to facilitate intubation in even the most challenging situations.	3.5-mm width/65-cm length with 1.2-mm suction channel 2.9-mm width/65-cm length with 1.2-mm suction channel 2.9-mm width/52-cm length with 1.2-mm suction port
<b>Flexible Intubation Video Endoscope (KARL STORZ Endoscopy)</b>	Compact, mobile endoscope. The FIVE Scope complements the C-MAC video intubation devices. All components, such as a camera control unit, camera head, light cable and light source, are already included in the C-MAC system. Distal chip technology enhances image quality, field of view, and aspect ratio to facilitate intubation.	5.5 mm with 2.3-mm suction channel 4.0 mm with 1.5-mm suction channel 2.85 mm without suction channel
<b>Insight Flexible Video Endoscope (Bell Medical)</b>	Has a universal HD Insight Color Display that is 3.5 in and stores 70 h of video and 80,000 pictures. Multiple-diameter FIS to work with infants and adults.	2.8, 4.0, 4.5 mm with 1.2-mm channel, 5.8 mm with and without channel

**Table 4. Video Laryngoscopes**

Name (Manufacturer)	Description	Size
<b>Airtraq Avant (Prodol Meditec; distributed by Teleflex)</b>	Disposable VL that provides a magnified angular view of the glottis without alignment of oral, pharyngeal, and tracheal axes. Includes a guiding channel to both hold and direct ET toward the vocal cords. Reusable optic piece (up to 50 intubations) and anti-fog heater resists lens clouding. Disposable blade and eyecup. MRI conditional use. Also, optional camera and smartphone adapter.	Regular adult (ETs 7.0-8.5 mm) Small adult (ETs 6.0-7.5 mm)
<b>Airtraq SP (Prodol Meditec; distributed by Teleflex)</b>	The SP model is single use with all the features of the Avant but fully disposable. The optional camera has an integrated touch screen and can be attached to all Airtraq models. It records and can connect via Wi-Fi to smartphone/iPad/iPhone/PC.	6 color-coded sizes: regular adult (ETs 7.0-8.5 mm); small adult (ETs 6.0-7.5 mm); pediatric (ETs 4.0-5.5 mm); infant (ETs 2.5-3.5 mm); nonchanneled blade; and DLTS

Clinical Applications	Special Features
Alternative to reusable FIS with large working channel (eg, for BAL or secretion management).	Fully disposable, sterile FIS avoids cleaning/reprocessing issues and repair costs. Attaches to high-quality aView monitor with onboard recording of video and images.
Alternative to standard reusable FIS.	Same as Ambu aScope 3 Large.
Equivalent to standard reusable pediatric FIS. Especially useful for positioning DLTs and bronchial blockers.	Same as Ambu aScope 3 Large.
Alternative to reusable FIS with large working channel (eg, for BAL or secretion management).	Same as aScope 3 Large but with improved image quality, better bending and new ergonomic design.
Alternative to standard reusable FIS.	Same as aScope 3 Regular but with improved image quality, better bending and new ergonomic design.
Equivalent to standard reusable pediatric FIS. Especially useful for positioning DLTs and bronchial blockers.	Same as aScope 3 Slim but with improved image quality, better bending and new ergonomic design.
Oral and transnasal intubation and lung separation. The small diameter of the FIVE S 3.5 scope is ideal for DLT placement (smallest is 35 Fr DLT) use with bronchial blockers, pediatric airways and maneuvering around challenging anatomy and obstructions to access the vocal cords when rigid devices fail to do so. The scopes are compatible with the C-MAC monitor and C-HUB Interface, offering a complete airway management distal chip video solution that couples FIS together with VL and optical stylets in a single platform. Includes built-in image and video capture capability.	This fully disposable, sterile FIS eliminates the need for reprocessing. Ideal in emergent settings such as the ICU, ED, and code carts for airway assessment and intubation.
Same as FIVE S Scope - Single-Use Flexible Intubation Video Endoscope.	4:3 aspect ratio and 300,000-pixel distal chip resolution allows improved visualization of the anatomy facilitating ET placement. Part of a system approach: 8403ZX C-MAC Monitor includes: Dual Device Input providing a "Plan B" that enables the use and simple exchange of several airway devices on one portable video platform (ie, switch from a video laryngoscope to a FIS). Improved image quality over FIS by eliminating moiré effect, providing more detailed anatomic images and permitting a full-screen image. Improved ergonomics with lighter-weight handle. Easier use with audible click to indicate neutral position. The scopes include a patented satin sheath for easy loading and advancing of ET without lubrication. Added length of 5 cm is optimal for DLT and bronchial blocker placement.
Features the 3.5 HD color display integrated with the endoscope. Easily removed for cleaning and sterilization.	Uses an LED light and LED camera at tip of the endoscope eliminating the fiber-optic bundles that can so easily be damaged. Articulates fully and easily to aid clinician in verifying DLT placement or in passing an ET on a difficult intubation.

Clinical Applications	Special Features
Intended to facilitate intubation in both routine and difficult airway situations. Useful in all cases where ET intubation is desired. Also appropriate for emergency settings, cervical spine immobilization, fiberoptic guidance, tube exchange, and foreign body removal.	Lightweight, hand-held video laryngoscope. Camera enables image capture/record as well as Wi-Fi streaming to larger monitors. Optics fully isolated from patient, preventing cross-contamination. Advanced airway device with built-in anti-fog system, and low-temperature light source. Can be used with standard ETs. Integral tracking channel allows ET to be directed without a stylet or bougie. May be used in MRI suite as MRI compatible.
Same as Airtraq Avant.	Same as Airtraq Avant but totally disposable and self-contained. 3-y shelf life.

table continues on next page

**Table 4. Video Laryngoscopes** (continued)

Name (Manufacturer)	Description	Size
<b>APA (AAM Healthcare)</b>	Offers continuous oxygen delivery during laryngoscopy, MAC and MIL style blades for use in pediatric, adult, and difficult airway patients. APA VL's modular design, along with its 3.5-in monitor, allows the user to choose the airway management technique required based on each patient. A disposable cover for the device is also available to protect it from contamination risks.	10 disposable blade types: MIL 1 and 2 (pediatric) MAC 3 and 4 (adult) DAB and U-DAB (channeled and unchanneled difficult airway blades) APA Oxy Blade MAC 3, 4, DAB and U-DAB (oxygenation blades)
<b>C-MAC (KARL STORZ Endoscopy)</b>	Instant-on, battery-powered VL with standard-shaped interchangeable MAC and MIL blades for neonates through obese adults as well as a difficult airway blade (D-BLADE) for very anterior airways. Blades house high-resolution CMOS distal chip and LED technology. Real-time viewing on 7-in LCD monitor. Dörge's D-BLADE has angle of view with approximately 80-degree acute curvature design.	MAC 0, 2, 3, 4; MIL 0, 1, 2, MAC 3 and 4 with channel for suction; adult and pediatric D-BLADE
<b>C-MAC Pocket Monitor (KARL STORZ Endoscopy)</b>	Highly portable rescue device, 3.5-in monitor fits directly on all C-MAC premium class blades. LCD 4.3 ratio high-resolution screen works in direct sunlight; rechargeable and removable lithium ion battery lasts 1 h; ergonomic screen can be moved in several directions and folded away for transport; fully immersible. Offers video and still picture recording conveniently located at the laryngoscope handle.	Can be used with reusable and single-use blades. Reusable: MAC 0, 2, 3, 4; MAC 3 and 4 with suction channel; MIL 0, 1, 2; adult and pediatric D-BLADE Single-use: MAC 3, 4; adult D-BLADE; MIL 0, 1
<b>C-MAC S (KARL STORZ Endoscopy)</b>	The highly versatile reusable S-Imager can be used with the C-MAC 7-in LCD monitor or portable 3.5-in Pocket Monitor. Both modalities offer video and still picture recording conveniently located at the laryngoscope handle. Anti-fog feature. Uses single-use blades. Imager is available in adult and pediatric size.	MAC 3, 4; adult D-BLADE; MIL 0, 1
<b>CoPilot VL+ (Dilon Technologies)</b>	Portable VL designed to be used in multiple settings for every intubation. Rechargeable lithium polymer battery provides >2 h continuous use. Durable and portable.	Adult size 3 and 4 disposable sheath blades with anti-fog coating
<b>GlideScope AVL (Verathon)</b>	Features a digital color monitor with integrated real-time recording, snapshot and on-screen playback capability. Video Batons incorporate the Reveal anti-fog mechanism to resist lens fogging. Six single-use blade options.	6 disposable blade sizes: 0, 1, 2, 2.5, 3, 4
<b>GlideScope Go (Verathon)</b>	GlideScope Go is the new hand-held, high-resolution VL system. Durable, portable, and intuitive, it uses the portfolio of fully disposable, single-use blades, designed to maximize first-pass success and minimize infection rates in routine and difficult intubation, in patients ranging from neonates to large adults.	6 single-use blades: LoPro S1, S2, S3 and S4; DirectView MAC S3, S4
<b>GlideScope Ranger (Verathon)</b>	Portable VL designed for EMS and military paramedics. Compact and rugged. Operational in seconds. Video Batons incorporate the Reveal anti-fog mechanism to resist lens fogging. Six single-use stat options.	6 disposable blades sizes: 0, 1, 2, 2.5, 3, 4
<b>GlideScope Titanium Reusable (Verathon)</b>	GlideScope Titanium system features high-resolution, full-color digital camera and monitor for real-time viewing and recording; features durable, lightweight titanium construction with built-in Reveal anti-fog mechanism; streamlined, low-profile blade designs; and snapshot and on-screen playback features.	4 reusable blade designs; LoPro 3 and 4 angled blades, and MAC-style 3 and 4 blades. Monitor compatible with AVL Video Batons and Spectrum Single-Use cable/blade options

Clinical Applications	Special Features
Suitable for use in EMS, military, ED, ICU, pediatric units, crash cart settings, and teaching hospitals to assist direct and indirect laryngoscopy in routine and difficult airways.	APA VL offers 6 styles of laryngoscopy on one device; traditional, MIL, pediatric, MAC, difficult airways, and its newest range of oxygenation blades for improving apnea time. Its dual battery system allows the device to be used as a traditional or video laryngoscope, offering users a customized solution with one device. The APA IP Shield is also available as a disposable cover aimed to reduce cross-contamination. APA Oxy Blade allows oxygenation directly into the oropharynx at recommended flow rates of 15 L/min during laryngoscopy. The standard oxygen connector allows attachment to any of the tapered oxygen outlet nozzles found on wall rotameters or on oxygen cylinders.
Useful for anterior airways, obese patients, and patients with limited mouth opening or neck extension. Variety of blade sizes and designs accommodates patients ranging from morbidly obese to neonate (500 g). Additionally, useful for teaching purposes, verification of ET position, aiding application of external laryngeal manipulation, or passage of an intubating introducer. May also be used for nasal intubation and ET exchange. Highly portable system for use in all hospital settings.	Unique platform design is compatible with multiple intubation devices, including VL, the F.I.V.E. distal chip flexible video scopes, and standard eyepiece scopes (fiber-optic and semirigid) via C-CAM camera head. Built-in still and video image capture on memory card, with real-time playback on monitor. Dual input capability allows for toggling between 2 devices, always ready for "Plan B." Angled distal lens provides 80-degree field of view. Inherent anti-fog design. Unit can be pole mounted or inserted into waterproof field bag. No special ETs or stylets needed. Can be used while battery is charging.
Ideal for ICU, crash carts, ED, and all prehospital environments including EMS, ambulatory services, air transport, and military. Has familiar blade design and 80-degree field of view.	Lightweight, handheld, and battery-operated device well suited for areas outside the OR. Waterproof. Proprietary data transfer cable allows for better patient information control. Extension cable allows for tomahawk approach when intubating patients in difficult positions (prehospital/emergency setting). Battery-saving auto shut-off feature with warning indicators, enables user to extend the reset timer with a push of the ergonomically placed blue button. Meets the RTCA/DO-160 F standard for electronic devices in airplanes and helicopters.
Same as C-MAC VL. When used with Pocket Monitor, most ideal for the ED, and all prehospital environments including EMS, ambulatory services, air transport, and military where reprocessing of blades can be a challenge. Also, suitable for NICU and PICU because of MIL 0 and 1 blade offering.	Available with a USB connector cable that can be used with RDT Tempus Pro vital signs monitor.
Blade angle useful for both routine and difficult airways.	Bright, full-color high-resolution camera and display. Only VL with patented bougie port to facilitate ET placement. 4.3-in display. Fog-free disposables.
High-quality airway view enables intubation in a wide range of adult and pediatric patients, including preterm/small child and large adult, bloody or anterior airways, and patients with limited neck mobility. Optimized for demanding applications in the OR, ED, ICU, and NICU. Can be used for teaching.	Real-time recording, onboard video tutorial, anti-fog feature to resist lens fogging, advanced resolution output to an external monitor, intuitive user controls and status icons, lightweight and easily transportable, impact-resistant, durable polycarbonate-coated video screen. Disposable blades allow quick turnaround and help limit the possibility of cross-contamination.
GlideScope Go is ideal for use in small spaces, emergent procedures, and whenever the situation demands mobility for routine and difficult airways.	Fully submersible IP67 rating; 3.5-in landscape color display with vertical tilt adjustment supporting a wide field of view; scratch-resistant screen with anti-glare coating; integrated battery delivers a minimum of 100 min of continuous use on a full charge; configurable auto-shutdown and automatic recording with removable micro-USB drive.
Ideal for EMS (ground and air), military, ED, and crash cart settings. Enables intubation of a wide range of patients, including preterm/small child and large adult, bloody or anterior airways, and patients with limited neck mobility.	The Ranger single-use VL system is compact, rugged, portable, and built to military and EMS specifications. Powered by rechargeable lithium polymer battery; 1.5 lb. Disposable blades allow quick turnaround and limit the possibility of cross-contamination.
VL options for routine and difficult airways—including new DirectView MAC blades—provide clinicians with a choice of airway tools for a wide range of patients, clinical settings, and teaching purposes. Low-profile designs are lightweight, ergonomic, and streamlined, offering improved maneuverability and working space for routine and difficult intubations.	LoPro blades with the signature GlideScope angulation; reusable blades are IPX8 with no cap required and have Reveal anti-fog technology.

table continues on next page

**Table 4. Video Laryngoscopes** (continued)

Name (Manufacturer)	Description	Size
<b>GlideScope Titanium Spectrum Single-Use (Verathon)</b>	GlideScope Spectrum Single-Use is the newest-generation VL from Verathon, featuring cutting-edge advances in lighting and camera technology and offers a comprehensive range of sizes for your smallest to largest patients, difficult to routine airways in a unique, fully disposable blade design.	6 single-use blade sizes: LoPro S1, S2, S3, S4 and DirectView MAC S3, S4. Monitor compatible with GlideScope Titanium Blades and AVL Video Batons/blade options.
<b>Insight VL (Bell Medical)</b>	One of 6 airway devices that use the universal HD Insight video display. Insight video display fits flexible endoscopes, rigid lighted stylet, and VL. The displays are interchangeable on all Insight devices.	4 disposable blades, including sizes MAC 1, 2, 3, and 4
<b>IntuBrite VLS 6600 Portable (Salter Labs)</b>	IntuBrite VLS 6600 uses a unique DUAL LED lighting system for exceptional clarity and anatomic definition. Large, high-resolution color display with vertical tilt adjustment. Video recording and still shot capability. Compatible range of reusable blades and single-use sheaths for neonates to adult patients. Durable aluminum and stainless steel handle and blade construction for demanding environments that require portability.	6 reusable blades for neonate to adult: MIL 0; MAC 1, 2, 3, 3 difficult, 4A difficult. 3 single-use sheath sizes for pediatric and adult.
<b>IntuBrite VLS 8800 (Salter Labs)</b>	IntuBrite VLS 8800 makes the benefits of video laryngoscopy accessible to all intubations in a high-quality system. Video recording and still shot capability. Compatible with a range of reusable blades and single-use sheaths for neonates to adult patients.	Similar to IntuBrite VLS 6600
<b>King Vision aBlade (Ambu)</b>	Reusable video adapter attaches to the existing display to allow use of lower-cost aBlades. Durable, fully portable digital VL with a high-quality reusable display and disposable aBlades. Hand-held, on-board display avoids cables and encourages patient focus.	aBlade sizes 1, 2, 2 channeled, 3, and 3 channeled
<b>King Vision (Ambu)</b>	Durable, fully portable digital VL with a high-quality reusable display and disposable blades. Hand-held, on-board display avoids cables and encourages patient focus; disposable blades incorporate camera and light source so fresh optics for each use.	Size 3 standard (13-mm minimum mouth opening) and size 3 channeled (18-mm minimum mouth opening); channeled blade allows ETs 6.0-8.0 mm
<b>McGrath MAC (Medtronic)</b>	Portable VL intubation platform designed for routine use. Equipped with either disposable MAC blades or hyperangulated blades for more anterior airways. Durable (drop tested to 2 m) and submersible. Screen displays minute-by-minute battery life countdown for improved reliability.	MAC blade sizes: 1, 2, 3, 4 X3 (hyperangulated)
<b>VividTrac (Fujifilm/SonoSite)</b>	Video intubation device that works on many computer systems equipped with USB II port as a standard USB camera, using available video camera applications on Windows, Mac, and Linux systems. Alternatively, automated video display software (VividVision) can be downloaded.	ETs 6.0-8.5 mm

Clinical Applications	Special Features
Same as GlideScope Titanium Reusable.	LoPro blades with the signature GlideScope curvature; anti-fog technology; blades incorporate Dynamic Light control and Ambient Light Reduction to optimize image quality and brightness at the vocal cords.
Ideal for routine and difficult airways. Has a HD 3.5" color display that rotates and tilts 270 degrees and a 3-plus-hour rechargeable battery, Wi-Fi, and HDMI-capable, photo and video with storage of 70 h or 80,000 photos, and anti-fog technology. The display can be removed for easy sterilization of blade handle.	Innovative Slider Design extends and contracts camera in seconds to allow one VL system to adjust to fit infant and pediatric laryngoscope blades up to adult and large adult blades. Integrated display and handle for total portability.
Range of blades facilitates intubation for routine and difficult intubations across the range of neonate to adult patients. Ideal for OR, ICU, NICU, ED, and EMS.	Unique white/UV Dual LED lighting for enhanced airway illumination. Real-time recording and still shots can be downloaded by cable or removable mini SD card. 3.5-in color monitor has vertical tilt adjustment. Rechargeable batteries with 1.5-2 h continuous use. Optically clear sapphire lens with integrated anti-fog heating system.
Similar to IntuBrite VLS 6600.	Unique white/UV Dual LED lighting for enhanced airway illumination. Real-time recording and still shots can be downloaded by removable mini SD card. 8-in monitor mounts on sturdy roll cart for easy portability. Optically clear sapphire lens with integrated anti-fog heating system. Flexible power options with rechargeable battery or cord.
Hyperangulated blade design facilitates both routine and difficult intubations.	Can be used alone or with other techniques. Powered by 3 AAA batteries; high-fidelity 2.4-in screen allows wide-angle viewing; anti-fog coating on blade window; side of channel is soft for separation of ET. Video out for connection to external display or video-capture device.
Hyperangulated blade design facilitates both routine and difficult intubations.	Can be used alone or with other techniques. Powered by 3 AAA batteries; high-fidelity 2.4-in screen allows wide-angle viewing; anti-fog coating on distal lens; side of channel is soft for separation of ET. Video out for connection to external display or video-capture device.
Combines the benefits of video-assisted and direct visualization with a complete blade range to encourage routine use of VL in the OR, ICU/ED, and EMS setting.	Requires no specialized training. Low-profile blades for improved agility and reduced dental interaction. Portrait-oriented display may help reduce blind spot. Highly portable, easy to clean and lightweight with no external cables.
Intended to facilitate intubation in both routine and difficult airway situations.	VividTrac is inserted more like an oral airway device (or SGA) than a laryngoscope blade. The ET can be preloaded or inserted once visualization is achieved in the VividTrac tube channel.

**Table 5. Specialty Rigid Laryngoscopes**

Name (Manufacturer)	Description	Size
<b>Dörge Emergency Laryngoscope Blade (KARL STORZ Endoscopy)</b>	Developed in Europe as a universal blade that combines features of both the MAC and MIL laryngoscope blades.	One size only for patients >10 kg to adult
<b>Modified MAC Blades</b>		
<b>Ainca Flex-Tip Fiber-Optic Laryngoscope Blade (Anesthesia Associates)</b>	Flexible tip or levering fiber-optic MAC laryngoscope blades designed with a hinged tip controlled by a lever at the proximal end. Designed to fit standard handles.	Adult sizes 3 and 4; pediatric size 2
<b>Ainca Macintosh Viewing Prism (Anesthesia Associates)</b>	An optically polished viewing prism for attachment to most MAC laryngoscope blades (conventional OR fiber-optic). Effectively repositions the practitioner’s viewpoint to the forward portion of the MAC curve via a 30-degree refraction without inverting the image. Clips to the vertical flange of the MAC to “look around the curve of the blade.”	Sizes 2, 3, and 4 for use on MAC laryngoscope blades of sizes 2, 3, and 4
<b>NOVALITE Flex-Tip Fiber Optic Blade (NOVAMED USA)</b>	Designed with an integrated fiber-optic bundle for maximized light transmission and optimal task illumination. Utilizing advanced XENON light technology, NOVALITE fiber-optic laryngoscopes deliver enhanced illumination for safer intubations.	MAC 2, 3, and 4
<b>NOVALITE MRI Conditional Laryngoscope (NOVAMED USA)</b>	Featuring NOVAMED “ULTRA BRITE” fiber-optic laryngoscope technology to afford clinicians a solution for intubations within the magnetic resonance (MR) environment—ensuring improved response time, enhanced patient safety, and minimized risk for trauma.	MAC 0-5; MIL 00-4

**Table 6. Supraglottic Ventilatory Devices**

Name (Manufacturer)	Description	Size
<b>AES Ultra (AES)</b>	All-silicone laryngeal mask with standard cuff valve.	Adult sizes 3-6
<b>AES Ultra Clear (AES)</b>	Silicone cuff and PVC tube, laryngeal mask with standard cuff valve.	Adult sizes 3-6
<b>AES Ultra EX (AES; distributed by Anesthesia Associates)</b>	All-silicone, multiple-use laryngeal mask.	Pediatric to adult sizes 1-6
<b>AES Ultra Flex EX (AES; distributed by Anesthesia Associates)</b>	All-silicone, wire-reinforced, multiple-use laryngeal mask.	Pediatric to adult sizes 1-6
<b>air-Q (Cookgas)</b>	Hypercurved intubating laryngeal airway that resists kinking, and removable airway connector. Anterior portion of mask is recessed; larger mask cavity allows intubation using standard ETs. air-Q removal after intubation is accomplished by using air-Q reusable removal stylet.	Sizes (0.5, 1.0, 1.5, 2.0, 2.5, 3.5, and 4.5) that can accommodate standard ETs 4.0-8.5 mm
<b>air-Q Blocker (Cookgas)</b>	Combines the features of air-Q Disposable laryngeal mask, with an additional soft, flexible guide tube located to the right of the breathing tube. This channel provides access to the esophagus with a NGT or Blocker tube that allows clinicians to vent, suction, and further block the esophagus.	Sizes (2.5, 3.5, and 4.5) that can accommodate standard ETs ≤8.5 mm; also available in kits with syringe and lubricant packet
<b>air-Q Disposable (Cookgas)</b>	Hypercurved intubating laryngeal airway with removable color-coded connectors. Anterior portion of mask is recessed; larger mask cavity allows intubation using standard ETs. air-Q removal after intubation is accomplished by using air-Q reusable removal stylet.	Sizes (1.0, 1.5, 2.0, 2.5, 3.5, and 4.5) that can accommodate standard ETs ≤8.5 mm

Clinical Applications	Special Features
Blade is inserted into oropharynx to appropriate depth, which correlates with patient's size.	10- and 20-kg markings on the blade.
Controlled manipulation of large or floppy epiglottis. Useful in patients with a recessed mandible and decreased mouth opening.	A lever controls the tip angle through 70 degrees during intubation to lift the epiglottis, if necessary, to improve laryngeal visualization.
Allows viewing of the vocal cords even in a patient with an anterior airway position. Also useful during nasal intubation (with impaired view) and for postoperative examination of the larynx.	Built-in clip on each prism allows attachment to any MAC-type laryngoscope blade that has a standard thickness vertical flange. Usable on both conventional and fiber-optic-type MAC blades. Reusable and sterilizable.
Positioning of the 5.0-mm fiber-optic bundle closer to the tip of the blade further enhances visibility and ensures ease of intubation.	Designed for interchangeability with universal Green System.
Powered by Lithium XENON technology, NOVALITE MRI Conditional fiber-optic laryngoscopes deliver enhanced illumination for safer intubations in the MR suite.	Certified to meet FDA MRI Conditional requirements up to 3.0 tesla. Compatible with Green System fiber-optic handles.

Clinical Applications	Special Features
Standard all-silicone SGA.	All silicone. Single use.
Combines all-silicone cuff with PVC tube for cost savings.	All silicone cuff with PVC tube. Single use.
Reusable, standard SGA.	40 uses.
Reusable, wire-reinforced SGA, designed to accommodate repositioning of the head and neck during surgery.	40 uses.
Allows easy access for FIS devices. Use as routine masked laryngeal airway. Removable connector allows intubation with standard ETs $\leq 8.5$ mm.	Designed to minimize folding of the cuff tip on insertion. Integrated bite block reinforces the tube while diminishing need for a separate bite block. Color-coded removable connectors tethered to the airway tube, avoiding episodes of misplaced connectors.
Enhanced version of the standard air-Q. Indicated as primary airway device when oral ET is not necessary or as aid to intubation in difficult situations.	The soft guide tube allows access to the posterior pharynx and esophagus by supporting and directing medical instruments beneath the air-Q mask and into the pharynx and esophagus. Medical instruments especially suited are suction catheters, NGTs up to size 18.0 Fr, and the newly designed air-Q Blocker tubes. The Blocker tubes are designed to suction the pharynx, or suction, vent, and block the upper esophagus during use of the air-Q Blocker airway. Removable color-coded connector allows intubation with standard ETs $\leq 8.5$ mm.
Same as air-Q reusable laryngeal mask.	Removable color-coded connector allows intubation with standard ETs $\leq 8.5$ mm.

table continues on next page

**Table 6. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>air-Q SP (Cookgas)</b>	Combines features of the air-Q reusable laryngeal masks with added advantage of a self-pressurizing mask. No inflation line or pilot balloon is needed. PPV or spontaneously breathing patients inflate the mask during the uptake of ventilation.	Sizes (0.5, 1.0, 1.5, 2.0, 2.5, 3.5, and 4.5) that can accommodate standard ETs 4.0-8.5 mm
<b>air-Q SP Disposable (Cookgas)</b>	Combines features of the air-Q disposable laryngeal masks with added advantage of a self-pressurizing mask. No inflation line or pilot balloon is needed. PPV or spontaneously breathing patients inflate the mask during the uptake of ventilation.	Sizes (1.0, 1.5, 2.0, 2.5, 3.5, and 4.5) that can accommodate standard ETs ≤8.5 mm
<b>Aura40 (Ambu)</b>	Same design as the Ambu AuraOnce, but reusable.	Pediatric to adult sizes 1-6
<b>Aura40 Straight (Ambu)</b>	Same design as the Ambu AuraStraight, but reusable.	Pediatric to adult sizes 1-6
<b>AuraFlex (Ambu)</b>	Disposable wire-reinforced flexible laryngeal mask.	Pediatric to adult sizes 2-6
<b>AuraGain (Ambu)</b>	Second-generation laryngeal mask, featuring anatomic curve for rapid placement, gastric access for suction and decompression of the stomach via a gastric tube, and integrated direct intubation capability for management of expected or unexpected difficult airway.	Pediatric to adult sizes 1-6
<b>Aura-i (Ambu)</b>	A laryngeal mask with built-in curve and bite blocker designed as a conduit for optical tracheal intubation.	Pediatric to adult sizes 1-6
<b>AuraOnce (Ambu)</b>	A laryngeal mask with a special built-in curve that replicates natural human anatomy. It is molded in 1 piece with an integrated inflation line and no epiglottic bars on the anterior surface of the cuff.	Pediatric to adult sizes 1-6
<b>AuraStraight (Ambu)</b>	A straight laryngeal mask featuring a single-mold design and an extra-soft, thin cuff which easily conforms to the airway.	Pediatric to adult sizes 1-6
<b>Block Buster Intubating Laryngeal Mask Airway (Bell Medical)</b>	Multifunctional intubating SGA made with silicone.	Adult sizes 3-5
<b>i-gel (Intersurgical)</b>	A second-generation, single-use SGA with a noninflating cuff, designed to mirror the perilaryngeal anatomy, with an integral bite block, buccal cavity stabilizer, and gastric channel. Also incorporates wide-bore airway channel for use as a conduit for intubation with flexible scope guidance (sizes 3-5).	Adult sizes 3-5 and pediatric sizes 1-2.5; adult sizes accommodate ETs 6.0-8.0 mm
<b>i-gel O<sub>2</sub> Resus Pack (Intersurgical)</b>	A second-generation, single-use SGA with a supplementary oxygen port designed to facilitate ventilation during CCR. A color-coded hook ring is used to secure the airway support strap and aids in size identification. Noninflating cuff that mirrors the perilaryngeal anatomy, with an integral bite block, buccal cavity stabilizer, and gastric channel. The pack contains an i-gel O <sub>2</sub> , a sachet of lubricant, and an airway support strap.	Adult sizes 3-5; adult sizes accommodate ETs 6.0-8.0 mm
<b>KING LT-D (Ambu)</b>	Disposable, single-lumen tube with 2 low-pressure cuffs. Intended for insertion into upper esophagus with ventilatory openings aligned with tracheal inlet; distal cuff seals the esophagus and the proximal cuff seals the oropharynx.	Adult sizes 3-5 and pediatric sizes 2, 2.5
<b>KING LTS-D (Ambu)</b>	Disposable double-lumen laryngeal tube with separate ventilation and gastric access channels. Intended for insertion into upper esophagus with ventilatory openings aligned with the tracheal inlet; distal cuff seals the esophagus and the proximal cuff seals the oropharynx.	Adult sizes 3-5 and pediatric sizes 0, 1, 2, 2.5

Clinical Applications	Special Features
More secure than a face mask and less invasive than intubation with an ET when tracheal intubation is not necessary or during unexpected difficult airway situation.	Incorporates the air-Q design with Self-Inflating Mask.
Same as regular air-Q but eliminates need for mask inflation.	PPV self-pressurizes mask cuff. On exhalation, mask cuff decompresses to level of PEEP. Removable connector allows intubation with standard ETs.
Routine use of SGA.	Reusable.
Routine use of SGA.	Reusable. Available only in US.
Designed for use in ENT, ophthalmic, dental, and torso surgeries.	Integrated pilot tube, and high flexibility enables positioning away from the surgical field, without loss of seal. Single use. EasyGlide texture and extra-soft cuff ease insertion and removal. Convenient depth marks for monitoring correct position of the mask.
Useful for ventilation and intubation. Appropriate for management of expected or unexpected difficult airway.	Allowable ET size is designated on each device; maximum OG tube size is also included (eg, 16 Fr for sizes 3-6). A soft, bite absorption area is integrated into the device as is a pilot fixator. Pediatric sizes 1 and 1.5 feature an innovative connector that reduces dead space by 39%.
Combines everyday routine use of SGA with direct intubation capability in case of difficult airway situations.	Anatomically correct curve designed as Ambu AuraOnce and Ambu Aura40 but specially designed as a conduit for intubation. Compatible with standard ETs.
Allows easy access for FIS devices. For use in both anesthesia and emergency medicine.	Anatomically correct curve facilitates placement. One-piece mold. EasyGlide texture for ease of insertion. Convenient depth marks for monitoring correct position of the mask. MRI safe. Extra-soft cuff. If intubation is necessary or desired, recommend intubation over Aintree AEC. Single use.
For use in both anesthesia and emergency medicine.	Single-use, one-piece mold. EasyGlide texture for ease of insertion. Convenient depth marks for monitoring correct position of the mask. MRI safe. Extra-soft cuff.
Capable of blind intubations with special design that tracks the ET into the trachea.	Gastric channel.
Indicated for use in routine and emergency anesthesia and resuscitation in adult patients. Can be used as a conduit for intubation with flexible scope guidance (sizes 3-5). Gastric channel provides early warning of regurgitation, allows for the passing of a NGT to empty the stomach contents, and can facilitate venting of gas from the stomach (except size 1).	Single-use, noninflating cuff allows easy and rapid insertion, provides high seal pressures, and minimizes risk for tissue compression. Gastric channel provides early warning of regurgitation. Buccal cavity stabilizer reduces risk for rotation or displacement and integral bite block prevents occlusion of airway channel. Wide-bore airway channel also allows for use as a conduit for intubation with flexible scope guidance (sizes 3- 5).
Indicated for use in routine and emergency anesthesia and resuscitation in adult patients. Can be used as a conduit for intubation with flexible scope guidance. i-gel O <sub>2</sub> also can be used to provide supplementary oxygen during postoperative care or patient transfer. Gastric channel provides early warning of regurgitation, allows for the passing of NGT to empty stomach contents and can facilitate venting of gas from the stomach.	Single-use, noninflating cuff allows easy and rapid insertion, provides high seal pressure, and minimizes risk for tissue compression. A supplementary oxygen port allows for administration of passive oxygenation as a component of CCR. Gastric channel provides early warning of regurgitation. Buccal cavity stabilizer reduces risk for rotation or displacement and integral bite block prevents occlusion of airway channel. The wide-bore airway channel also allows for use as a conduit for intubation with flexible scope guidance.
Useful for routine or emergency airway management. Two cuffs provide elevated ventilatory seal; esophageal cuff provides physical barrier in esophagus, reducing gastric insufflation and providing potential aspiration protection. Commonly used in EMS.	Both cuffs are inflated with a single pilot tube/valve; printed depth marks; color-coded 15 mm connectors for each size. Also available in a compact, vacuum-sealed kit with inflation syringe and lube.
Useful for routine or emergency airway management. Two cuffs provide elevated ventilatory seal; esophageal cuff provides physical barrier in esophagus, reducing gastric insufflation and providing potential aspiration protection. Separate gastric access channel allows venting and active removal of gastric fluids. Commonly used in EMS.	Both cuffs are inflated with a single pilot tube/valve; printed depth marks; color-coded 15-mm connectors for each size. Large gastric port (sizes 3-5 allow 18 FR OG tube passage). Also available in a compact, vacuum-sealed kit with inflation syringe and lube.

table continues on next page

**Table 6. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>LMA Classic (Teleflex)</b>	Safe, general-purpose airway for routine elective inpatient and outpatient surgical procedures.	Adult sizes 3-6 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Classic Excel (Teleflex)</b>	Has the benefits of LMA Classic, and its improved design facilitates intubation.	Adult sizes 3-5
<b>LMA Fastrach (Teleflex)</b>	Designed to facilitate blind intubation without moving head or neck, allowing for single-handed insertion. Allows continuous ventilation between intubation attempts.	Adult sizes 3-5 that can accommodate special ETs 6.0-8.0 mm
<b>LMA Flexible (Teleflex)</b>	Has a reinforced airway tube that allows it to be positioned away from the surgical field while maintaining a good seal.	Adult sizes 3-6 and pediatric sizes 2, 2.5
<b>LMA Gastro with Cuff Pilot Technology (Teleflex)</b>	LMA specifically designed to give clinicians control of their patients' airways while facilitating direct endoscopic access via the integrated endoscope channel. Once placed, the LMA Gastro Airway facilitates end-tidal CO <sub>2</sub> monitoring throughout the procedure to support patient safety.	Adult sizes 3-5
<b>LMA ProSeal (Teleflex)</b>	Double-cuff design enables seal pressures $\geq 30$ cm H <sub>2</sub> O to be achieved, and the drain tube separates the alimentary and respiratory tracts.	Adult sizes 3-5 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Protector with Cuff Pilot Technology (Teleflex)</b>	Second-generation SGA with silicone cuff designed to achieve an oropharyngeal seal equivalent to the LMA ProSeal Airway ( $>30$ cm H <sub>2</sub> O). Combines a pharyngeal chamber and dual gastric drainage channels, designed specifically to minimize gastric insufflation and facilitate gastric access.	Adult sizes 3-5
<b>LMA Supreme (Teleflex)</b>	Combines features of previous LMAs to provide increased safety and ease of use. The higher seal pressure and gastric access provide a higher degree of safety. Designed to channel fluids away from the airway in the unlikely event of active or passive regurgitation and allows for diagnostic positioning.	Adult sizes 3-5 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Unique (Teleflex)</b>	Original, single-use LMA with design based on LMA Classic. Available with or without syringe and lubricant.	Adult sizes 3-5 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Unique EVO with Cuff Pilot Technology (Teleflex)</b>	First-generation, silicone cuffed LMA that offers ET intubation capabilities.	Adult sizes 3-5
<b>LMA Unique with Cuff Pilot Technology (Teleflex)</b>	A versatile, single-use, first-generation laryngeal mask with a medical-grade silicone cuff and integrated cuff pressure manometer.	Adult sizes 3-6 and pediatric sizes 1, 1.5, 2, 2.5

Clinical Applications	Special Features
Although originally developed for airway management of routine cases with spontaneous ventilation, it is now listed in the ASA Difficult Airway Algorithm as an airway ventilatory device or a conduit for tracheal intubation. Can be used in both pediatric and adult patients in whom ventilation with a face mask or intubation is difficult or impossible. Can also be used as bridge to extubation and with pressure support or PPV.	Aperture bars designed to prevent blockage of the airway by the epiglottis. Reusable $\leq 40$ times. Silicone cuff. Not made with natural rubber latex.
Improves on features of the original LMA Classic Airway, facilitating intubation, and is reusable $\leq 60$ times.	Removable connector and epiglottic elevating bar to facilitate intubation. Works with ET $\leq 7.5$ mm. Reusable $\leq 60$ times. Silicone cuff. Not made with natural rubber latex.
Designed for anatomically difficult airway and included in AHA's and ASA's difficult airway algorithms.	Supplied as either a sterile version for single-use only, or as a reusable version that may be used $\leq 40$ times. Silicone cuff. Not made with natural rubber latex.
Ideal for ENT, ophthalmic, and dental surgery, or other procedures where the surgeon and anesthesiologist compete for airway access.	Supplied as either a sterile version for single use only, or as a reusable version that may be used $\leq 40$ times. Not made with natural rubber latex.
Designed to provide control of a patient's airway while enabling direct access to the esophagus and upper gastrointestinal tract in adult patients undergoing endoscopic procedures.	Silicone airway tube and cuff designed for smooth insertion and patient comfort. Endoscope channel enables an endoscope (max OD, 14 mm) to be passed through the device under vision. Cuff Pilot Technology, an integrated cuff pressure indicator that provides constant at-a-glance feedback, alerting clinicians to changes in cuff pressure. Integral bite block reduces the potential for damage to, or obstruction of, the airway tube or endoscope due to biting. Adjustable holder and strap maintains the device in a neutral position during endoscope manipulation. Single use. Sterile. Not made with natural rubber latex. MRI safe.
The drain tube higher seal pressures together with the flexible airway tube enable longer periods of ventilation with minimal posterior pharyngeal wall damage, therefore expanding the types of procedures where a LMA can be used.	Second cuff allows tighter seal for PPV. Silicone cuff. Reusable $\leq 40$ times. Not made with natural rubber latex.
For routine procedures or to manage high-risk patients.	Elongated, inflatable silicone cuff is designed to conform to the contours of the hypopharynx and achieve an oropharyngeal seal equivalent to the LMA ProSeal Airway ( $>30$ cm H <sub>2</sub> O). The esophageal seal secures the distal tip at the upper esophageal sphincter and is designed to minimize gastric insufflation and facilitate gastric access. Proprietary dual gastric drainage channel and suction ports, combined with a high-capacity gastric chamber, allowing for suction and decompression of the stomach via a gastric tube, while providing exit channels for gastric contents in the event of regurgitation. The airway tube allows for direct flexible scope-aided intubation with ETs $\leq 7.5$ mm. Single use. Sterile. Not made with natural rubber latex. MRI safe.
For routine procedures or to manage higher-risk patients.	Allows for easy insertion, higher seal pressures, and provides gastric access to suction or decompress the stomach. First Seal Technology is designed to provide adequacy of gas exchange. Second Seal Technology is designed to reduce risk for insufflation during ventilation. Designed to provide a passive conduit for unexpected regurgitation. The angle of the LMA Supreme Airway facilitates ease of insertion in various head positions. Single use. Sterile. Not made with natural rubber latex.
Same as LMA Classic. Included in AHA 2000 Guidelines for CPR and Emergency Medicine Cardiovascular Care.	Aperture bars designed to prevent the blockage of airflow by the epiglottis. Single use. Sterile. Not made with natural rubber latex.
Enhanced design is ideal for unforeseen airway complications where intubation becomes necessary, and the silicone cuff is designed to be gentle to the anatomy.	Also features Cuff Pilot Technology, an integrated cuff pressure indicator that provides constant at-a-glance feedback, alerting clinicians to changes in cuff pressure. Single use. Sterile. Not made with natural rubber latex. MRI safe.
The LMA Unique Airway is an ideal choice for routine anesthetic procedures, for difficult airway situations, or for airway management during cardiopulmonary resuscitation.	Silicone cuff is soft and flexible, and conforms to the anatomy to create an effective oropharyngeal seal. Aperture bars designed to prevent the blockage of airflow by the epiglottis. Cuff Pilot Technology, an integrated cuff pressure indicator that provides constant at-a-glance feedback, alerting clinicians to changes in cuff pressure. Single use. Sterile. Not made with natural rubber latex. MRI safe.

table continues on next page

**Table 6. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>Portex Clear PVC, Oral/Nasal, Soft Seal Cuff Tracheal Tubes (Smiths Medical)</b>	Similar in shape to the first-generation laryngeal mask, but differs in its 1-piece design, in which the cuff is softer and there is no “step” between the tube and the cuff, an integrated inflation line, no epiglottic bars on the anterior surface of the cuff, and a wider ventilation orifice.	Pediatric to adult sizes 1-5
<b>Shiley (Medtronic)</b>	A disposable, cost-effective LM airway with integrated cuff inflation line. Designed to form a low-pressure seal around the laryngeal inlet and maintain a secure airway.	Pediatric to adult sizes 1-6
<b>Shiley Esophageal Endotracheal Airway, Double Lumen (Medtronic)</b>	A disposable DLT that combines the features of a conventional ET with those of an esophageal obturator airway. Has a large proximal latex oropharyngeal balloon and a distal esophageal low-pressure cuff with 8 ventilatory holes in between.	Two adult sizes: 41 Fr, height >5 ft; 37 Fr, height 4-6 ft
<b>Soft-Seal (Smiths Medical)</b>	Similar in shape to the first-generation laryngeal mask, but differs in its 1-piece design, in which the cuff is softer and there is no “step” between the tube and the cuff, an integrated inflation line, no epiglottic bars on the anterior surface of the cuff, and a wider ventilation orifice.	Pediatric to adult sizes 1-5
<b>Solus Curve (Intersurgical)</b>	Solus Curve is a single-use SGA designed for those who prefer the insertion characteristics of a curved device. It includes a classic cuff shape, integral inflation line, and a high-quality valve.	Adult sizes 3-5
<b>Solus Flexible (Intersurgical)</b>	A single-use SGA range with a wire-reinforced tube, permitting flexion without kinking. It includes a classic cuff shape, integral inflation line, and a high-quality valve.	Adult sizes 3-5 and pediatric sizes 2 and 2.5
<b>Solus MRI Safe (Intersurgical)</b>	A range of single-use SGA fitted with specially tested nonferrous valves, guaranteed not to interfere with the magnet in an MRI scanner. The plastic valve has been selected to ensure full reliability throughout the shelf life of each device.	Adult sizes 3-5 and pediatric sizes 1, 1.5, 2, 2.5
<b>Solus Satin (Intersurgical)</b>	A range of single-use SGA with a softer airway tube to provide more flexibility. Provides a classic cuff shape, an integral inflation line, and a high-quality valve to ensure continual cuff integrity.	Adult sizes 3-5
<b>Solus Standard (Intersurgical)</b>	A range of single-use SGA featuring a low-friction material, classic cuff shape, integral inflation line, and a high-quality valve.	Adult sizes 3-5 and pediatric sizes 1, 1.5, 2, 2.5

**Table 7. Devices for Special Airway Techniques**

Name (Manufacturer)	Description	Size
<b>Awake Intubation</b>		
<b>Model 15-RD Glass Atomizer (DeVilbiss Healthcare)</b>	Metal atomizer; includes glass receptacle (for liquid), pair of metal outlet tubes extending from metal atomizing nozzle, and adjustable tip for directing spray to inaccessible areas of the throat. Can be used with or without RhinoGuard tip cover.	Length: 10.5 in
<b>Break-Away Airway (Bell Medical)</b>	Intubation airway designed for use with a FIS for difficult intubation. The airway acts as an intubation guide to direct the scope. Once ET is inserted, the airway easily spreads or breaks away from the ET, allowing for the airway to be removed from the patient’s mouth.	Adult, ET ≤9.0 mm
<b>Capnography and Oxygen Mask for Procedural Sedation, POM Mask (Bell Medical)</b>	Designed for delivering high concentrations of oxygen and monitoring end-tidal CO <sub>2</sub> during procedural or conscious sedation cases, such as upper GI, ERCP, EUS, and EGD.	Pediatric to adult size masks

Clinical Applications	Special Features
Allows easy access for flexible scope devices.	If intubation necessary or desired, will accommodate ET up to 7.5 mm. Single use.
Suitable for spontaneous, assisted, or controlled ventilation during routine and emergency anesthetic procedures.	Single use, disposable, contoured tube soft cuff with integrated cuff inflation line.
Routine use of SGA but not contraindicated in nonfasting patients. Appropriate for prehospital, intraoperative, and emergency use. Especially useful for patients in whom direct visualization of vocal cords is not possible, patients with massive airway bleeding or regurgitation, limited access to airway, and patients in whom neck movement is contraindicated.	Ventilation possible with either tracheal or esophageal intubation. Distal cuff seals off the esophagus to prevent aspiration of gastric contents. Allows passage of an OG tube when placed in the esophagus. Single use.
Allows easy access for flexible scope devices.	If intubation necessary or desired, will accommodate ET $\leq$ 7.5 mm. Single use.
Same as Solus Flexible.	Same as Solus Satin.
Indicated for use in anesthesia and emergency medicine. Solus Flexible is an ideal solution for airway management in procedures such as ENT, dental, oromaxillary, and eye surgery.	Same as Solus Satin.
Same as Solus Satin.	Same as Solus Satin.
Indicated for use in anesthesia and emergency medicine. Single-use SGA comes sterile and ready for use.	Classic cuff shape for optimum anatomic conformance with a firm, smooth-surfaced back plate to aid ease of insertion. Essential information, such as the device size, is prominently displayed at the top of the tube and on the pilot balloon for quick visual reference. Not made with natural rubber latex.
Same as Solus Satin.	Same as Solus Satin.

Clinical Applications	Special Features
Intended for the application of topical anesthetics to the nose, oropharynx, and upper airway of patients, at the direction/discretion of a clinician.	Includes glass receptacle for dispensing the liquid; adjustable swivel top and vented nasal guard attached to a hand bulb. Can be used with all types of oil or water solutions that are compatible with rhodium metal plating. The all-metal top can be autoclaved. Reusable.
Packaged both individually and in bulk.	Disposable airway, single-patient use.
Dual oral and nasal entry ports for endoscopes, optimizes oxygen concentrations, measures capnography even at high oxygen flows, allows easy unobstructed view and access to patient.	Ideal for oral or nasal FSI while keeping patient oxygenated.

table continues on next page

**Table 7. Devices for Special Airway Techniques** (continued)

Name (Manufacturer)	Description	Size
<b>EZ-Spray EZ-100 (Alcove Medical)</b>	Atomizer that delivers a 15- to 60-micron mist of medication in a cost-effective, easy to use, disposable unit.	Length: 7.125 in; height: 4.125 in Nozzle: 0.313 × 0.563 in Bottle diameter: 1.375 in
<b>LMA MAD Nasal (Teleflex)</b>	Disposable, compact atomizer for delivery of medications to the nose and throat in a fine, gentle mist.	Typical particle size: 30-100 microns; system dead space: 0.13 and 0.07 mL; tip diameter: 0.17 in (4.3 mm); applicator length: 1.65 in (4.2 cm)
<b>LMA MADgic Airway (Teleflex)</b>	For difficult and awake airways requiring a FIS, the device combines atomized topical anesthetic and oxygen delivery in an innovative and elegantly designed flexible scope-compatible oral airway.	Typical particle size: 30-100 microns; system dead space: 0.15 mL; oxygen flow rate: 2-3 L/min at 50 psi; size: 9-cm airway (ETs 6.5-8.0)
<b>LMA MADgic (Teleflex)</b>	Mucosal atomization device that incorporates a small flexible, malleable tube with an internal stiffening stylet that connects to 3-mL syringe.	Typical particle size: 30-100 microns; system dead space: 0.25 and 0.13 mL; tip diameter: 0.18 in (4.6 mm); applicator length: 8.5 in (21.6 cm) and 4.5 in (11.4 cm)
<b>LMA MADomizer Bottle Atomizer (Teleflex)</b>	Bottle atomizer comes with a positive displacement pump for delivering a variety of medications to the nose and hypopharynx.	Typical particle size: 30-100 microns; tip diameter: 0.17 in (4.3 mm); applicator length: 4 in (10 cm)
<b>Retrograde Intubation</b>		
<b>Cook Retrograde Intubation Set (Cook Medical)</b>	Available as a complete set in 6.0, 11, or 14 Fr. The 14 Fr version includes Airway Exchange Catheter with Rapi-Fit adapters allow for delivery of oxygen.	6.0 Fr=50 cm; 11 Fr=70 cm; 14 Fr=70 cm, extra-stiff flexible J-tipped guidewire = 110 cm
<b>Face Mask Ventilation and Nasal Oxygenation</b>		
<b>Comfort Flo (Teleflex)</b>	Heated Humidified High Flow Nasal Cannula Therapy (HH-HFNCT)	Premature, infant, pediatric, and adult
<b>Endoscopy Mask (VBM)</b>	Face mask with diaphragm to allow simultaneous ventilation and endoscopy.	Newborn, infant, child, and adult
<b>Ergomask (Tuoren Medical Inc/Richard's Medical)</b>	Mask with asymmetrical dome with a contoured ridge and a colored marker for finger placement.	Color-coded adult sizes: 3 (small), 4 (medium), and 5 (large)
<b>Flow-Safe II+ Disposable BiLevel CPAP System (Mercury Medical)</b>	Disposable BiLevel CPAP system with deluxe mask with comfortable head harness, including a color-coded manometer for verifying BiLevel CPAP or CPAP pressure. Flow-Safe II+ works with standard flowmeters that can deliver >10 cm H <sub>2</sub> O CPAP pressure or approximately 10 cm H <sub>2</sub> O IPAP pressure at 15 L/min. The Bilevel CPAP switch allows clinicians to provide either therapy mode.	Child, small adult, and large adult
<b>Flow-Safe II EZ CPAP System (Mercury Medical)</b>	System includes an integrated nebulizer that requires only 1 oxygen source to run both the CPAP and nebulizer devices. CPAP system includes color-coded manometer for verifying CPAP pressure and pressure-relief system. Flow-Safe II EZ works with standard flowmeters that can deliver >10 cm H <sub>2</sub> O at 15 L/min. Higher flow pressures may be necessary when running both CPAP and the nebulizer.	Child, small adult, and large adult

Clinical Applications	Special Features
Application of topical anesthetic to the nose, oropharynx, and upper airway of patients.	Trigger-valve system provides controlled release of compressed gas to atomizing nozzle, creating liquid spray. Gas flow adjusted to desired setting. Use with either oil- or water-based solutions. Nonsterile. Single use.
Intranasal medication delivery offers rapid, effective method to deliver selected medications to patient without need for a painful shot and without delays in onset seen with oral medications.	Rapidly effective (atomized nasal medications absorb directly into bloodstream, avoiding first-pass metabolism; atomized nasal medications absorb directly into the brain and cerebrospinal fluid via olfactory mucosa to nose-brain pathway, achieves medication levels comparable to injections). Controlled administration (exact dosing, exact volume, titratable to effect [repeat if needed]; atomizes in any position; atomized particles are optimal size for deposition across broad area of mucosa).
For use with FIS.	Intubating airway with mucosal atomization and oxygen delivery.
Application of topical anesthetics to oropharynx and upper airway region. Fits through vocal cords, down SGA, or into nasal cavity.	Malleable applicator retains memory to adapt to individual patient's anatomy. Delivery of a fine spray mist generated by a piston syringe. Luer connection adapts to any luer lock syringe. Nonsterile. Single use.
Delivers topical anesthetics, vasoconstrictors, and other nasal or oral medications. Allows targeted delivery of exact drug doses to the nasal and oral mucosa.	Unique pump design and disposable applicator tip reduces the risk for patient cross-contamination that can occur with compressed air atomizers. One-way check valve ensures unidirectional flow.
Technique used for securing a difficult airway, either alone or with other alternative airway techniques. Especially useful in patients with limited neck mobility or patients who have suffered airway trauma. 6.0 Fr places tubes $\geq 2.5$ mm ID; 11 Fr places tubes $\geq 4.0$ mm; 14 Fr places ETs $\geq 5$ mm ID.	Packaged as a complete kit with everything needed to perform a retrograde intubation. Recently added Arndt AEC allows for patient oxygenation and facilitates placement of an ET. Disposable.
Utilization of High Flow Nasal Cannula Therapy (HFNCT) in appropriate patients can improve oxygenation, decreasing the patient's work of breathing and help combat sedation-related respiratory complications during preoxygenation, induction, and post extubation.	Safe and effective delivery of HH-HFNCT. Supports flow rates ranging from 1 to 60 L/min. Customizable airway temperature and gradient control to optimize HFNCT.
FSI; airway endoscopy; gastroenterology; transesophageal echocardiography.	Available in different sizes and with different sizes of diaphragms for a perfect seal during endoscopy. Special bronchoscope airway available to protect equipment and aid endoscopy.
One- and 2-handed BVM ventilation.	Ergonomic design optimizes the 1-handed ventilation technique. Improved seal with chin lift, head extension.
Requires only 1 oxygen source for delivering CPAP or BiLevel CPAP pressure. Easy EPAP dial allows adjustable EPAP pressure in the BiLevel CPAP mode. Includes a built-in manometer for verified pressure readings. No assembly of separate apparatus, and the pressure-relief valve automatically adjusts to avoid excess pressure.	The lightweight disposable feature allows for easy CPAP or BiLevel CPAP therapy setup and therapy delivery during transport. Flow-Safe II+ is ideal for situations where backup BiLevel CPAP equipment is scarce or unavailable. The contoured, double-seal deluxe mask is designed to form a very good anatomic seal. The elastic head harness is easy to place, with Velcro straps that easily adjust for patient comfort.
The Flow-Safe II EZ CPAP device is a respiratory aid intended for use with a face mask, nebulizer, and gas-supplying device to elevate pressure in the patient's lungs while delivering aerosolized medication.	Mask features elastic head harness, quick-disconnect clips, and straight rotating port. Built-in manometer and pressure-relief valve. CPAP and nebulization through a single oxygen source.

table continues on next page

**Table 7. Devices for Special Airway Techniques** (continued)

Name (Manufacturer)	Description	Size
<b>Optiflow THRIVE System</b> (Fisher & Paykel Healthcare)	Humidified oxygenation system with heated inspiratory tubing and anatomically designed high-flow nasal cannula. Packaged in box of 10.	Small, medium, and large
<b>Super NO<sub>2</sub>VA Nasal PAP Ventilation System</b> (Vyair Medical)	Nasal mask capable of delivering noninvasive PPV when connected to an anesthesia circuit or Mapleson circuit utilizing low fresh gas flows from simple wall oxygen.	Medium and large
<b>Transtracheal Jet Ventilation</b>		
<b>Ainca Manual Jet Ventilator</b> (Anesthesia Associates)	Portable jet ventilation device with thumb depression mechanism that initiates controlled burst of oxygen flow. Customizable assembly includes DISS inlet connection, 5 ft of inlet tubing, flow control knob, on/off thumb control, internal filter, back pressure gauge, and 2 ft of outlet hose ending in a luer-lock male fitting. Connects to any tool or port that has a luer-lock female connection (ie, malleable stylets, various adapters, etc).	Jet ventilation catheters of malleable copper with luer lock fittings accommodate adults, children, and infants. Adapters allow direct connection to bronchoscope or ET.
<b>Ainca MRI Conditional 3.0-Tesla Jet Ventilator</b> (Anesthesia Associates)	Similar to Ainca Manual Jet Ventilator but certified MRI conditional-compatible for use in units $\leq 3.0$ Tesla strength.	Jet ventilation catheters of malleable copper with luer lock fittings accommodate adults, children, and infants. MRI conditional 3.0 Tesla.
<b>GO-PAP</b> (Pulmonary)	Emergency disposable CPAP device, with integrated nebulization.	FiO <sub>2</sub> - approximately 30% 3 PEEP settings BiTrac ED Mask
<b>Manual Jet Ventilator</b> (Instrumentation Industries)	Complete set includes an on/off valve, 6 ft of high-pressure tubing, and 4 ft of small-bore tubing.	Jet ventilation catheter size 13 G can accommodate adults, and 14 G children.
<b>Manujet III</b> (VBM)	Complete set including 13-ft high-pressure hose assembly with oxygen DISS fittings, 40-degree small-bore tube assembly (with luer lock fitting) and 3 jet ventilation catheters (13, 14, and 16 G).	Jet ventilation catheters can accommodate adults, children, and infants.
<b>O2-MAX</b> (Pulmonary)	Emergency disposable CPAP device, with integrated nebulization.	FiO <sub>2</sub> - approximately 30% 3 PEEP settings BiTrac ED Mask
<b>O2-MAX Trio</b> (Pulmonary)	Emergency disposable CPAP device, with integrated nebulization.	3 FiO <sub>2</sub> levels 3 PEEP settings BiTrac ED Mask
<b>Transtracheal Catheter</b> (Acutronic Medical System)	Small jet needle for puncturing the trachea in an emergency for use with jet ventilation.	13 G, 14 G

**Table 8. Positioning Devices**

Name (Manufacturer)	Description
<b>Chin-UP Airway Support Device</b> (Dupaco; distributed by Mercury Medical)	Hands-free airway support device used to lift up patient's chin and hold it in position to keep the airway open.
<b>Face-Cradle Prone Support System</b> (Mercury Medical)	Fully adjustable cushion set accommodates most adult head sizes.

Clinical Applications	Special Features
Humidification of nasal high-flow oxygen for perianesthesia. May be used in peri-intubation for general anesthesia to extend the safe apnea time (preoxygenation, induction, extubation). Also used for oxygenation during procedural sedation and post-anesthesia recovery.	Extends the safe apnea time by preventing oxygen desaturation and clearing CO <sub>2</sub> from the lungs. Optiflow THRIVE delivers gas flows up to 70 L/min, up to 100% oxygen, and provides up to 7 cm H <sub>2</sub> O positive airway pressure.
Designed to deliver noninvasive nasal PPV to maintain upper airway patency and provide ventilatory support for patients. Ideal for patients with morbid obesity, obstructive sleep apnea, and cardiopulmonary disease intraoperatively or during sedation using an anesthesia circuit and postoperatively during emergence when connected to a Mapleson circuit. With open access to the oral cavity, nasal PPV can also be continued during intraoral procedures such as EGD, TEE, and bronchoscopy to combat hypoxemia and respiratory compromise.	Perioperative device to maintain upper airway patency and provide continuous oxygenation and ventilation. Nasal mask may also be beneficial for mask ventilation in edentulous patients and those with facial hair and high BMI.
Manual jet ventilation for oxygen saturation maintenance and usable for emergency direct TTJV and for laser throat surgery (elimination of plastic ET in laser path).	Easy factory customization available for hose lengths and oxygen source connection type (DISS vs various quick-disconnect types) as well as optional pressure regulator (with gauge) and standard or custom regulator-to-source connection hoses. Adapters, fittings, and connectors available. Completely reusable and sterilizable.
Similar to the AincA Manual Jet Ventilator, but fully certified for use in MRI suites with coil strength to 3.0 tesla. Allows emergency oxygen saturation maintenance while determining how to solve airway issues.	Easy factory customization available for hose lengths and oxygen source connection type (DISS vs various quick-disconnect types). Adapters, fittings, and connectors available. Completely reusable and sterilizable.
Offers PEEP levels 5, 7.5, 10 cm H <sub>2</sub> O with FiO <sub>2</sub> level of ~30%. Constant flow and PEEP levels maintained, due to PEEP and flow being independent from the oxygen levels in the tank. Uses the barbed valve on a generator with a flow of 10 L/min.	Disposable CPAP generator with 3 combinations of FiO <sub>2</sub> and PEEP. Integrated nebulizer closed-circuit system built directly into the elbow. Neb-Connect Accessory available, which allows nebulization and CPAP therapy off of the same tank.
Same as Manujet III. Can also be used in unobstructed difficult airway management.	Offered with and without an adjustable pressure regulator. Partially reusable outlet tube is disposable. Note: Outlet tube is single use.
Well-accepted method for securing ventilation in rigid and interventional bronchoscopy. Because airflow is generally unidirectional, it is important that air has a route to escape (unobstructed airway).	Packaged as complete kit with jet ventilation catheters to perform TTJV. Includes gauge and regulator.
Offers PEEP levels 2.5-20 cm H <sub>2</sub> O. With FiO <sub>2</sub> level of ~30%. Constant flow and PEEP levels maintained, due to PEEP and flow being independent from the oxygen levels in the tank. Uses the 50 PSI port.	Disposable CPAP generator with ≤21 cm H <sub>2</sub> O specific combinations of FiO <sub>2</sub> and PEEP. Integrated nebulizer closed-circuit system built directly into the elbow.
Offers PEEP levels 2.5-20 cm H <sub>2</sub> O. Allows dial-in FiO <sub>2</sub> levels of ~30%, 60%, and 90%. Constant flow and PEEP levels maintained, due to PEEP and flow being independent from the oxygen levels in the tank. Uses the 50 PSI port.	Disposable CPAP generator with ≤21 cm H <sub>2</sub> O specific combinations of FiO <sub>2</sub> and PEEP. Integrated nebulizer closed-circuit system built directly into the elbow.
Applications in ICU for patients with severe lung injuries, ARDS, or bronchopleural fistulas.	Provides ventilation to patient who is unable to be intubated.

Clinical Applications	Special Features
Aids during monitored anesthesia care and total IV anesthesia sedation procedures.	Disposable polyurethane foam cushions.
For use in prone-position surgeries.	Fully adjustable offering the clinician greater visibility of patient's face.

table continues on next page

**Table 8. Positioning Devices** (continued)

Name (Manufacturer)	Description
<b>Pi's Pillow</b> (American Eagle Medical)	Consists of a foam base and removable pad that supports the head in full extension position (sniffing) and maintains proper alignment of the upper airway during airway management.
<b>Rapid Airway Management Positioner (RAMP)</b> (Airpal Patient Transfer Systems)	Air-assisted medical device that can be inflated to transfer and position patients for various procedures.
<b>Troop Elevation Pillow</b> (CR Enterprises; distributed by Mercury Medical)	Foam positioning device that quickly achieves the H.E.L.P. Includes many accessories (head cradle, arm board pads, and TEPA). An impermeable barrier cover is also offered for infection control and to protect the product.

**Table 9. Cricothyrotomy Devices**

Name (Manufacturer)	Description	Size
<b>Needle Cricothyrotomy</b>		
<b>Emergency Transtracheal Airway Catheter</b> (Cook Medical)	6 Fr reinforced fluorinated ethylene propylene catheter.	5.0 and 7.5 cm
<b>Percutaneous Cricothyrotomy</b>		
<b>Control-Cric</b> (Pulmodyne)	Contents include a Cric-Knife, which is a dual-sided 10-mm scalpel with integrated sliding tracheal hook, and a Cric-Key, which is a cuffed 5.5-mm cric tube, with a preloaded stylet to allow for tactile feedback of the tracheal rings.	5.5-mm cric tube
<b>Melker Cuffed Emergency Cricothyrotomy Catheter Set</b> (Cook Medical)	Complete set including syringe (10 cc), 2- to 18-G introducer needles with TFE catheter (short and long), 0.038-in diameter Amplatz extra-stiff guidewire with flexible tip, scalpel, curved dilator with radiopaque stripe, and PVC airway catheter. Also available in a Special Operations kit, which includes all of the above in a slip peel pouch and 2 airway catheters.	Standard kit: 3.8 cm (3.5 mm ID), 4.2 cm (4 mm ID), and 7.5 cm (6 mm ID); special kit: 4.2 and 7.5 cm
<b>Pertrach Emergency Cricothyrotomy Kit</b> (Pulmodyne)	Contents include 2 splitting needles, cuffed or uncuffed trach tube, dilator with flexible leader, twill tape, syringe, extension tube, and scalpel (optional).	Adult: 6.8 cm (5.6 mm ID) Child: 3.9 cm (3 mm ID), 4 cm (3.5 mm ID), 4.1 cm (4 mm ID), and 4.4 cm (5.0 mm ID)
<b>Quicktrach I</b> <b>Quicktrach II</b> (VBM)	Complete set includes airway catheter, stopper, needle, and syringes that come preassembled. Quicktrach I (without cuff) Quicktrach II (with cuff)	Adult (4 mm ID) Child (2 mm ID)
<b>Surgical Cricothyrotomy</b>		
<b>Melker Surgical Cricothyrotomy Set</b> (Cook Medical)	Cuffed cricothyrotomy tube, scalpel, tracheal hook Trousseau dilator, and blunt, curved dilator in compact package for convenient storage.	9 cm (5 mm ID)
<b>Melker Universal Cuffed Emergency Cricothyrotomy Catheter Set</b> (Cook Medical)	Same as Melker Cuffed Emergency Cricothyrotomy Catheter Set for percutaneous technique. Also includes for surgical technique: tracheal hook, safety scalpel, Trousseau dilator, and blunt curved dilator.	9 cm (5 mm ID)
<b>Rüsch Easycric</b> (Teleflex)	Complete Seldinger-based cricothyrotomy set, premounted EasyCric tube and dilator (hydrophilic coated, anatomically shaped).	Adult (size 5)
<b>ScalpelCric</b> (VBM)	Scalpel cricothyrotomy set "stab-twist-bougie-tube"	6 mm ID
<b>Surgicric</b> (VBM)	Surgical cricothyrotomy set. Surgicric I: rapid 4-step technique; Surgicric II: classic surgical technique; Surgicric III: Seldinger technique	6 mm ID

Clinical Applications	Special Features
Significantly facilitates ventilation and intubation and supports a difficult airway; also helpful in a lateral position, such as in the performance of colonoscopy. Effectively raises a patient's head, neck and shoulders to chest level, creating an extended head position and making ventilation and intubation easy and safe for an obese patient; helps with a patient's breathing when administering monitored anesthesia care.	Available in disposable and reusable models. The disposable pillow comes with a vacuum package and can easily be stored even within a small OR. A barrier cover is provided for the pillow. Four sizes: small, medium, large and extra-large (obesity pillow).
Allows for the positioning of a patient for laryngoscopy, extubation, and central venous access. Enhances the safe apnea period, bag valve mask ventilation, and chest wall excursion.	Base of RAMP is integrated with an Airpal platform (air-assisted lateral patient transfer and positioning device). Inflates and deflates, thus can remain in place during surgery and reinflate for extubation. Reusable.
Aids airway management for obese patients by aligning upper airway axes. This improves ease of mask ventilation and facilitates intubation via DL or VL. Allows patients to breathe more comfortably during preoxygenation as well as during regional anesthesia.	Disposable and reusable formats. TEPA may be added to the TEP base unit for super morbidly obese patients (BMI >50 kg/m <sup>2</sup> )

Clinical Applications	Special Features
A lifesaving procedure that is the final option for "cannot-ventilate, cannot-intubate" patients in all airway algorithms.	Designed to be kink-resistant, specifically for the purpose of needle cricothyrotomy.
Same as Emergency Transtracheal Airway Catheter.	Designed to perform cricothyrotomy without the need for visualization, air aspiration, or reliance on fine motor skills. Packaged to simplify the procedure.
Same as Emergency Transtracheal Airway Catheter, is intended to establish emergency airway access when tracheal intubation cannot be performed. Also intended for use with the Seldinger technique via cricothyroid membrane; however, has capability to be used as a surgical cricothyrotomy.	Packaged as complete kit with everything needed to perform a percutaneous cricothyrotomy. The Special Operations kit comes in a slip peel pouch for easy transport to off-site locations. Also can be used in OR. Comes with 2 differently sized airway catheters to reduce number of kits needed in the field. Disposable.
Use in failed orotracheal or nasotracheal intubation, and/or flexible scope bronchoscopy. Immediate airway control in patients with maxillofacial, cervical spine, head, neck, and multiple trauma. Also used when tracheal intubation is impossible and/or contraindicated. Immediate relief of upper airway block.	Serves as an emergency cricothyrotomy or tracheostomy device that uses a patented splitting needle and dilator to perform rapid and simple procedures.
Wide-bore cannula cricothyrotomy set	Packaged as complete set with everything needed to perform a percutaneous cricothyrotomy. Removable stopper is used to prevent a "too-deep" insertion and avoid the possibility of perforating the rear tracheal wall. Conical needle tip allows for the smallest necessary stoma and reduces the risk for bleeding. Easily transported to off-site locations.
This set provides the tools that clinicians can use if they prefer a surgical approach to performing emergency cricothyrotomy.	Complete and convenient packaging.
Same as Melker Cuffed Emergency Cricothyrotomy Catheter Set.	50% of tray same as Melker Cuffed Emergency Cricothyrotomy Catheter Set for the percutaneous technique. The other 50% includes all items needed to perform a surgical emergency cricothyrotomy.
EasyCric emergency cricothyrotomy set is a backup device when every other procedure is impossible.	Special hydrophilic coating and anatomic design of the entire device (premounted tube and dilator, ergonomic grip, fixed neck plate), facilitates insertion and handling by the clinician.
Same as Melker Cuffed Emergency Cricothyrotomy Catheter Set.	Complete cricothyrotomy set, which includes: size 10 scalpel; 40 cm, 14 Fr bougie; 6 mm cuffed tube.
Three different sets that provide clinicians several choices for the performance of emergency cricothyrotomy.	Small pack size ideal for emergency bags. Soft tip is atraumatic. Locking mechanism prevents accidental dislocation.

**Table 10. Tracheostomy Devices**

Name (Manufacturer)	Description	Size
<b>Percutaneous Dilatational Tracheostomy</b>		
<b>Blom Tracheostomy Tubes (Pulmodyne)</b>	Available in 4 sizes. Each size offers the choice of nonfenestrated and uncuffed tubes, as well as fenestrated cuffed/uncuffed tubes along with other standard inner cannulas.	4, 6, 8, and 10 mm
<b>Ciaglia Blue Rhino G2 and Blue Dolphin BT Balloon-Assisted Percutaneous Tracheostomy Introducers (Cook Medical)</b>	Complete kit includes 24, 26, and 28 Fr loading dilators and Shiley 6 or 8 percutaneous disposable dual-cannula tracheostomy tube. Tray version available that includes lidocaine/epinephrine, connector, chlorhexidine skin prep, drape, needle driver, and suture.	74 mm (6.4 mm ID); 79 mm (7.6 mm ID)
<b>Laserjet Catheter (Acutronic Medical Systems)</b>	Double-lumen jet catheter.	Diameter: 12 Fr; length: 40 cm, 70 cm
<b>Portex Ultraperc Percutaneous Dilation Tracheostomy Kit (Smiths Medical)</b>	Complete set with or without a tracheostomy tube.	70 mm (7 mm ID); 5.5 mm (8 mm ID); 81 mm (9 mm ID)
<b>Shiley Flexible Adult Tracheostomy Tube (Medtronic)</b>	Each size features the choice of cuffed (with the patented TaperGuard cuff technology) or uncuffed versions.	4, 5, 6, 7, 8, 9, 10 mm
<b>Shiley TracheoSoft XLT Extended-Length Tracheostomy Tubes (Medtronic)</b>	Available in 4 ISO sizes (5, 6, 7, and 8 mm ID). Each size offers the choice of cuffed or uncuffed stylets, and proximal or distal extensions. Disposable inner cannula; replacements sold in packages of 10.	90 mm (5 mm ID); 95 mm (6 mm ID); 100 mm (7 mm ID); 105 mm (8 mm ID)
<b>Weinmann Tracheostomy Exchange Set (Cook Medical)</b>	Includes Cook Airway Exchange Catheter, Tracheostomy loading dilators, and a Blue Rhino dilator for redilation if necessary.	For use with tracheostomy tubes as follows: 74 mm (6.4 mm ID); 79 mm (7.6 mm ID)
<b>Surgical Tracheostomy</b>		
<p>Surgical tracheostomies are performed by making a curvilinear skin incision along relaxed skin tension lines between sternal notch and cricoid cartilage. A midline vertical incision is then made dividing strap muscles, and division of thyroid isthmus between ligatures is performed. Next, a cricoid hook is used to elevate the cricoid. An inferior-based flap or Bjork flap (through second and third tracheal rings) is commonly used. The flap is then sutured to the inferior skin margin. Alternatives include a vertical tracheal incision (pediatric) or excision of an ellipse of anterior tracheal wall. Finally, the tracheostomy tube is inserted, the cuff is inflated, and it is secured with tape around the neck or stay sutures.</p>		

**Abbreviation Key**

<b>AEC</b> airway exchange catheter	<b>CPV</b> Cuff Pilot Valve	<b>EUS</b> Endoscopic ultrasound
<b>AHA</b> American Heart Association	<b>DAB</b> difficult airway blade	<b>EVA</b> Expiratory Ventilation Assistance
<b>ARDS</b> acute respiratory distress syndrome	<b>DCI</b> direct-coupled interface	<b>FDA</b> US Food and Drug Administration
<b>ASA</b> American Society of Anesthesiologists	<b>DISS</b> diameter index safety system	<b>FIO2</b> fraction of inspired oxygen
<b>AVL</b> Advanced Video Laryngoscope	<b>DL</b> direct laryngoscopy	<b>FIS</b> flexible intubation scope
<b>BAL</b> bronchoalveolar lavage	<b>DLT</b> double-lumen tube	<b>FIVE</b> Flexible Intubation Video Endoscope
<b>BMI</b> body mass index	<b>ED</b> emergency department	<b>Fr</b> French
<b>BVM</b> bag-valve-mask	<b>EF</b> extra firm	<b>FSI</b> flexible scope intubation
<b>CCD</b> charge-coupled device	<b>EGD</b> esophagogastroduodenoscopy	<b>GI</b> gastrointestinal
<b>CCR</b> cardiocerebral resuscitation	<b>EMS</b> emergency medical services	<b>GVL</b> GlideScope Video Laryngoscope
<b>CMOS</b> complementary metal oxide semiconductor	<b>ENT</b> ear, nose, and throat	<b>HD</b> high-definition
<b>CO2</b> carbon dioxide	<b>EPAP</b> expiratory positive airway pressure	<b>HDMI</b> High-Definition Multimedia Interface
<b>CPAP</b> continuous positive airway pressure	<b>ERCP</b> endoscopic retrograde cholangiopancreatography	<b>HELP</b> Head Elevated Laryngoscopy Position
<b>CPR</b> cardiopulmonary resuscitation	<b>ET</b> endotracheal tube	<b>HFNCT</b> High Flow Nasal Cannula Therapy

Clinical Applications	Special Features
Features a variety of unique inner cannulas that aid in the clearance and management of secretions to help prevent ventilator-associated events and help allow speech.	Subglottic suctioning inner cannula helps manage patient secretions that pool above the cuff intermittently or continuously through fenestrations.
Establishes transcutaneous access to the trachea below level of cricoid cartilage. Allows for smooth insertion of the tracheostomy tube over a Seldinger wire.	Each product is packaged as a complete kit with everything needed to perform a percutaneous tracheostomy. The hydrophilic coating/soft tip of the Blue Rhino dilator, and radial balloon dilation technique with Dolphin BT, are designed for simple, less traumatic insertions. The wire guides have Safe-T-J tips to reduce trauma. Disposable.
For use in laser airway procedures and difficult airway procedures.	Laser-safe tube; dual lumen provides extra ability for monitoring of pressures and end-tidal CO <sub>2</sub> .
Establishes transcutaneous access to the trachea below level of cricoid cartilage. Allows for smooth insertion of the tracheostomy tube over a Seldinger wire.	Packaged as a complete kit with everything needed to perform a percutaneous dilatational tracheostomy. The dilator is single-staged and prelubricated with an ergonomic handle to facilitate insertion. Disposable.
The tracheostomy tube is a single-use device.	The tracheostomy tube features a soft, flexible shaft, beveled tip and a clear flange with airflow vents around the integrated 15-mm connector.
Flexible dual-cannula tube for patients with unusual anatomy. Proximal length extension for thick necks; distal length extension for long necks, tracheal stenosis, or tracheomalacia.	The only fixed-flange extended-length tube with disposable inner cannula. Flexible inner cannula conforms to shape of the outer cannula. 16 configurations to fit a wide variety of patients. Disposable.
Used to facilitate exchange of adult tracheostomy tubes allowing for stomal redilation, if required.	The only device available that provides an AEC to maintain stomal access and allows redilation of stoma if resistance is met.

**HH-HFNCT** Heated Humidified High Flow Nasal Cannula Therapy  
**ICU** intensive care unit  
**ID** internal diameter  
**ILMA** intubating laryngeal mask airway  
**IPAP** inspiratory positive airway pressure  
**ISO** International Organization for Standardization  
**IV** intravenous  
**LCD** liquid crystal display  
**LED** light-emitting diode  
**LM** laryngeal mask  
**LMA** Laryngeal Mask Airway  
**LT** laryngeal tube  
**MAC** Macintosh

**MIL** Miller  
**MRI** magnetic resonance imaging  
**NGT** nasogastric tube  
**NICU** neonatal intensive care unit  
**NTSC** National Television System Committee  
**OD** outer diameter  
**OG** orogastric  
**OR** operating room  
**PAP** positive airway pressure  
**PEEP** positive end-expiratory pressure  
**PICU** pediatric intensive care unit  
**POM** procedural oxygen mask  
**PPV** positive-pressure ventilation  
**PSI** Pneumonia Severity Index  
**PVC** polyvinyl chloride

**PVP** polyvinylpyrrolidone  
**RDT** Remote Diagnostic Technologies  
**RTCA** Radio Technical Commission for Aeronautics  
**SGA** supraglottic airway  
**TEE** transesophageal echocardiography  
**TEP** Troop Elevation Pillow  
**TEPA** Troop Elevation Pillow Addition  
**TFE** tetrafluoroethylene  
**TTJV** transtracheal jet ventilation  
**U-DAB** unchanneled difficult airway blade  
**UV** ultraviolet  
**USB** universal serial bus  
**VL** video laryngoscope/laryngoscopy  
**VLM** video laryngeal mask

## Recommended Reading

- Agro F, Barzoi G, Montecchia F. Tracheal intubation using a Macintosh laryngoscope or a GlideScope in 15 patients with cervical spine immobilization (letter). *Br J Anaesth*. 2003;90(5):705-706.
- Aoyama K, Nagaoka E, Takenaka I, et al. The McCoy laryngoscope expands the laryngeal aperture in patients with difficult intubation. *Anesthesiology*. 2000;92(6):1855-1867.
- Audenaert SM, Montgomery CL, Stone B, et al. Retrograde-assisted fiberoptic tracheal intubation in children with difficult airways. *Anesth Analg*. 1991;73(5):660-664.
- Aziz M, Abrons RO, Cattano D, et al. First-attempt intubation success of video laryngoscopy in patients with anticipated difficult direct laryngoscopy: a multicenter randomized controlled trial comparing the C-MAC D-Blade versus the GlideScope in a mixed provider and diverse patient population. *Anesth Analg*. 2016;122(3):740-750.
- Borg PA, Hamaekers AE, Lacko M, et al. Ventrain for ventilation of the lungs. *Br J Anaesth*. 2012;109(5):833-834.
- Brimacombe J, Keller C, Hörmann C. Pressure support ventilation versus continuous positive airway pressure with the laryngeal mask airway: a randomised, crossover study of anesthetized adult patients. *Anesthesiology*. 2000;92(6):1621-1623.
- Cavallone LF, Vanucci A. Extubation of the difficult airway and extubation failure. *Anesth Analg*. 2013;116(2):368-383.
- Cavus E, Neumann T, Doerges V, et al. First clinical evaluation of the C-MAC D-Blade video laryngoscope during routine and difficult intubation. *Anesth Analg*. 2011;112(2):382-385.
- Cook T, Woodall N, Frerk C, et al. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: anaesthesia. *Br J Anaesth*. 2011;106(5):617-631.
- Cook T, Woodall N, Frerk C, et al. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 2: intensive care and emergency departments. *Br J Anaesth*. 2011;106(5):632-642.
- Cooper RM. Use of a new videolaryngoscope (GlideScope) in the management of a difficult airway. *Can J Anesth*. 2003;50(6):611-613.
- Corley A, Caruana L, Barnett A, et al. Oxygen delivery through high-flow nasal cannulae increase end-expiratory lung volume and reduce respiratory rate in post-cardiac surgical patients. *Br J Anaesth*. 2011;107(6):998-1004.
- Davis L, Cook-Sather SD, Schreiner MS. Lighted stylet tracheal intubation: a review. *Anesth Analg*. 2000;90(3):745-756.
- Dörges V, Ocker H, Wenzel V, et al. The laryngeal tube: a new simple airway device. *Anesth Analg*. 2000;90(5):1220-1222.
- Enk D. Gas flow reversing element. Patent US 8,950,400 B2. United States Patent and Trademark Office; February 10, 2015.
- Enk D, Busse H, Meissner A, et al. A new device for oxygenation and drug administration by transtracheal jet ventilation. *Anesth Analg*. 1998;86(25):S203.
- Frass M, Kofler J, Thalhammer F, et al. Clinical evaluation of a new visualized endotracheal tube (VETT). *Anesthesiology*. 1997;87(5):1262-1263.
- Frerk C, Mitchell VS, McNarry AF, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth*. 2015;115(6):827-848.
- Gaitini LA, Vaida SJ, Somri M, et al. A comparison of the Cobra, Perilaryngeal Airway, and Laryngeal Mask Airway Unique in spontaneously breathing adult patients. *Anesthesiology*. 2004;101:A518.
- Gomez-Rioz M, Freire-Vila E. The Totaltrack: an initial evaluation. *Br J Anaesth*. 2015;115(5):799-800.
- Gorback MS. Management of the challenging airway with the Bullard laryngoscope. *J Clin Anesth*. 1991;3(6):473-477.
- Groves N, Tobin A. High flow nasal oxygen generates positive airway pressure in adult volunteers. *Aust Crit Care*. 2007;20(4):126-131.
- Gupta B, McDonald JS, Brooks JH, et al. Oral fiberoptic intubation over a retrograde guidewire. *Anesth Analg*. 1989;68(4):517-519.
- Hamaekers AE, Borg PA, Enk D. Ventrain: an ejector ventilator for emergency use. *Br J Anaesth*. 2012;108(6):1017-1021.
- Hauswald M, Hauswald EK. Percutaneous cricothyroid jet ventilation using repetitive airway obstruction: a quick and simple way to ventilate the "impossible" airway. *Acad Emerg Med*. 2016;23(9):e16-e17.
- Hooshangi H, Wong DT. Brief review: the Cobra Perilaryngeal Airway (CobraPLA) and the Streamlined Liner of Pharyngeal Airway (SLIPA) supraglottic airways. *Can J Anaesth*. 2008;55(3):177-185.
- Kristensen MS, de Wolf MWP, Rasmussen LS. Ventilation via the 2.4 mm internal diameter Tritube® with cuff - new possibilities in airway management. *Acta Anaesthesiol Scand*. 2017;61(6):580-589.
- Kristensen M. The Parker Flex-Tip Tube versus a standard tube for fiberoptic orotracheal intubation: a randomized double-blind study. *Anesthesiology*. 2003; 98(2):354-358.
- Lorenz V, Rich JM, Schebesta K, et al. Comparison of the EasyTube and endotracheal tube during general anesthesia in fasted adult patients. *J Clin Anesth*. 2009;21(5):341-347.
- Miller CG. Management of the difficult intubation in closed malpractice claims. *ASA Newsletter*. 2000;64(6):13-19.
- Moore A, Gregoire-Bertrand F, Massicotte N, et al. I-gel versus LMA-Fastrach supraglottic airway for flexible bronchoscope-guided tracheal intubation using a Parker (GlideRite) endotracheal tube: a randomized controlled trial. *Anesth Analg*. 2015;121(2):430-436.
- Noppens RR. Ventilation through a "straw": the final answer in a totally closed upper airway? *Br J Anaesth*. 2015;115(2):168-170.
- Patel P, Verghese C. Delayed extubation facilitated with the use of a laryngeal mask airway in the intensive care unit. *Anaesthesia*. 2000;55(4):396.
- Paxian M, Preussler NP, Reinz T, et al. Transtracheal ventilation with a novel ejector-based device (Ventrain) in open, partly obstructed, or totally closed upper airways in pigs. *Br J Anaesth*. 2015;115(2):308-316.
- Ritchie J, Williams A, Gerard C. Evaluation of a humidified nasal high-flow oxygen system, using oxymetry, capnography and measurement of upper airway pressures. *Anaesth Intensive Care*. 2011; 39(6):1103-1110.
- Willemsen MG, Noppens R, Mulder AL, Enk D. Ventilation with the Ventrain through a small lumen catheter in the failed paediatric airway: two case reports. *Br J Anaesth*. 2014;112(5):946-947.
- Xue FS, Cheng Y, Li RP. Awake intubation with video laryngoscope and fiberoptic bronchoscope in difficult airway patients. *Anesthesiology*. 2013;118(2):462-463.
- Zamora J, Nolan R, Sharan S, et al. Evaluation of the Bullard, GlideScope, Viewmax, and Macintosh laryngoscopes using a cadaver model to simulate the difficult airway. *J Clin Anesth*. 2011;23(1):27-34.
- Zaouter C, Calderon J, Hemmerling TM. Videolaryngoscopy as a new standard of care. *Br J Anaesth*. 2015;114(2):181-183.