



# Current Concepts In the Management of The Difficult Airway

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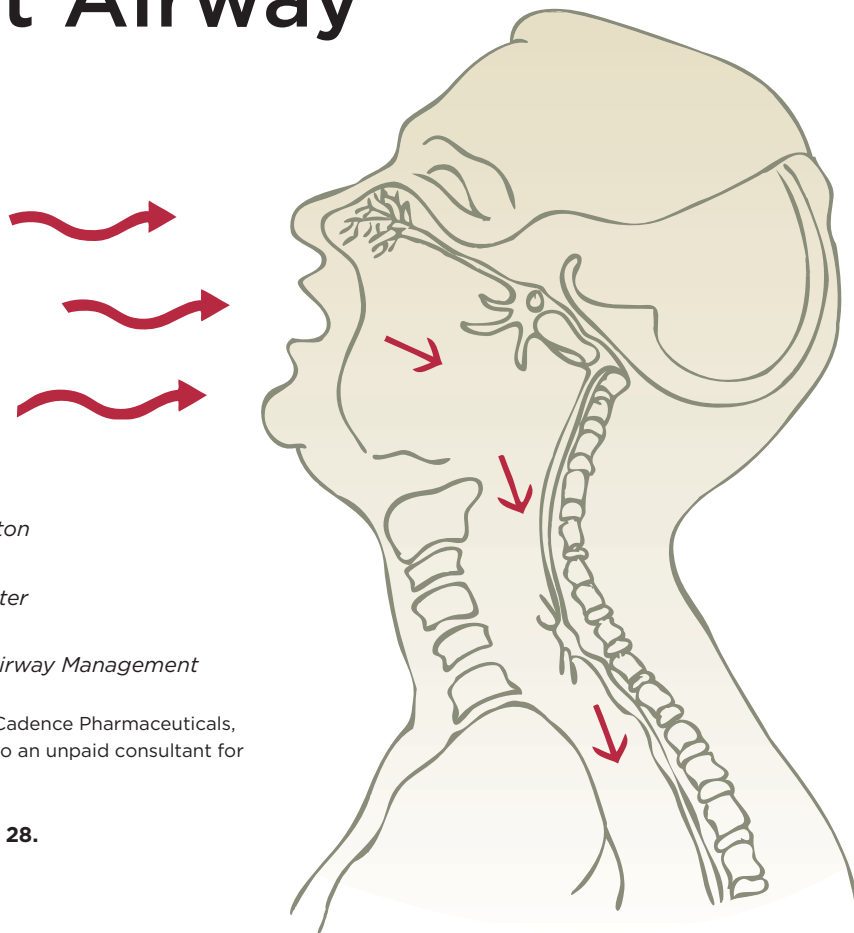
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**Editor's note: All acronyms are listed on page 28.**



**M**anagement of the difficult airway remains one of the most relevant and challenging tasks for anesthesia care providers. This review focuses on several of the alternative airway management devices/techniques and their clinical applications, with particular emphasis on the difficult or failed airway. It includes descriptions of many new airway devices, several of which have been included in the ASA Difficult Airway Algorithm.<sup>1</sup>

## **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 Tube Guides***

Several ET guides have been used to aid in intubation or extubation, including both reusable/disposable and solid/hollow introducers, stylets, and tube exchangers (Table 1).

### ***Lighted Stylets***

In the past decade, many lighted stylets have been developed, including light wands, which rely on transillumination of the tissues of the anterior neck to demonstrate the location of the tip of the ET—a blind technique, unless combined with DL, and visual scopes, which use fiber-optic imagery and allow indirect visualization of the airway. They also can be used alone or in conjunction with DL (Table 2).

### ***Viewing Stylets***

Viewing stylets provide a view from the tip of the ET. Whereas the view from a VL is at the end of the laryngoscope, viewing 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).

### ***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 will be described (Table 3).

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

These laryngoscopes were designed to facilitate tracheal intubation in the same population that would be considered for flexible fiber-optic bronchoscopy, such as patients with limited mouth opening or neck movement. Relative to the flexible FOBs, 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 FOBs), 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 4).

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

The 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 fiber-optic-guided intubation (Table 5).

## **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 7).

Atomizing devices currently available for delivering topical anesthesia to nasal, oral, pharyngeal, laryngeal, and tracheal tissues include the DeVilbiss Model 15 Medical Atomizer (DeVilbiss Healthcare), the Enk Fiber-optic Atomizer Set (Cook Medical), the LMA MADgic Laryngo-Tracheal Atomizer (Teleflex), and the LMA MADgic Airway (Teleflex). Although any technique of tracheal intubation can be performed under topical anesthesia, flexible fiber-optic intubation is most commonly used.

### ***Flexible Fiber-Optic Intubation***

Flexible fiber-optic intubation 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. A completely disposable system, the aScope (Ambu) also is available. 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 6) 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.

### **Transtracheal Jet 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 6). The Enk Oxygen Flow Modulator (Cook Medical) can be used when jet ventilation is appropriate but not available. An MRI Conditional 3.0 Tesla manual jet ventilator (Anesthesia Associates, AincA) also is now available to enable TTJV in the MRI suite for both planned and emergency procedures (Table 6). The Ventrain (Ventinova Medical B.V.) is a single-use ventilation device specifically designed for difficult or obstructed airway situations. It not only supplies oxygen during the inspiration phase, but also actively removes gas from the lungs with Expiratory Ventilation Assistance.

### **Cricothyrotomy**

Cricothyrotomy (Table 8), 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 9) 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.

### **Reference**

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

**Table 1. Endotracheal Tube Guides**

Name (Manufacturer)	Description	Length, cm
<b>Aintree Intubation Catheter (Cook Medical)</b>	Polyethylene 19 Fr AEC allows passage of an FOB 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 8.0 and 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 extension. Coude 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 Catheters (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.	Accommodates ETs $>5.0$ mm ID
<b>CoPilot VL Single-Use Bougie (Magaw Medical)</b>	14 Fr polyethylene single-use ET introducer with coude tip. Color: orange.	60; accommodates ETs $\geq 6.0$ mm ID
<b>CoPilot VL Rigid Stylet (Magaw Medical)</b>	Reusable CoPilot VL intubation stylet.	Accommodates ETs $\geq 6.0$ mm ID
<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, 65
<b>GlideRite Rigid Stylet (Verathon)</b>	Reusable, sterilizable, semirigid stylet that conforms to GlideScope unique blade angulation; provides improved maneuverability in ET placement.	26.6; accommodates ETs $\geq 6.0$ mm ID
<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; accommodates ETs $\geq 5.0$ mm ID
<b>Muallem ET Tube Stylet (VBM Medizintechnik)</b>	Single-use 8.0, 12, 14 Fr stylet; malleable, but with soft and atraumatic coude tip. Color: green.	40, 65
<b>OptiShape Stylet (Teleflex)</b>	Reusable, sterilizable, semirigid stylet with optimal shape memory for indirect intubation procedures.	4 sizes; accommodates ETs 2.5-3.5, 4.0-5.5, 5.0-6.5, and 7.0-9.0 mm ID
<b>Pocket Introducer (VBM Medizintechnik)</b>	Single-use 15 Fr Introducer with coude tip. Color: blue.	65
<b>Portex Venn Tracheal Tube Introducer (Smiths Medical)</b>	15 Fr ET introducer made from a woven polyester base, with a coude tip (angled 35 degrees at its distal end). Also known as the gum elastic bougie. Color: golden brown.	60
<b>Rapid Positioning intubation Stylet (RPIS) (Airway Management Enterprises)</b>	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; accommodates ETs $\geq 6.0$ mm ID
<b>Rhinoguard (Davis Medical)</b>	ET introducer/dilator.	25.4 cm: small for 3.0-4.5 ETs; 35.5 cm: large for 5.0-8.0 ETs

Clinical Applications	Special Features
Exchange of SGAs for ETs $\geq 7.0$ mm using an FOB. Its hollow lumen allows insertion of an FOB directly through the catheter so that the airway can be indirectly visualized.	Large lumen (4.7 mm) allows passage of FOB. 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 FOB.	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.
Facilitate endotracheal intubation especially in situations of difficult airway anatomy.	Telescoping segment to enhance glottis entry. Malleable, reversible, and controllable from middle or either end.
Facilitate endotracheal 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.
Facilitate endotracheal intubation. May also be used for tube exchange.	Single use.
Reusable CoPilot VL intubation stylet for use with VL to facilitate ET placement.	Reusable, easy to high level disinfect or sterilize.
Facilitates endotracheal 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.
Designed to work with GlideScope AVL, GVL, Cobalt, and Ranger VLS to facilitate intubations in OR, ED, and emergency settings.	Reusable, durable stainless steel; easy to clean and sterilize in an autoclave.
Designed to facilitate endotracheal intubation for both DL and VL. Unique curvature designed to follow natural path of airway. Flexibility allows for manipulation of distal tip for anterior airways. Customizable coude tip angles.	Self-lubricated bougie, Tactiglide technology for tactile sensation, optimal curve with shape memory, balanced rigidity with soft-tissue protection, nonremovable depth markings, packaged sterile.
Difficult 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 $>42$ -degree angles. 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 $>42$ -degree angle of vision.
Facilitates endotracheal 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.
Provides greater visibility and control of tip similar to a FOB (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.

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

Name (Manufacturer)	Description	Length, cm
<b>Single-Use Bougie (Smiths Medical)</b>	15 Fr, PVC ET introducer with coude tip. Has a hollow lumen that discourages reuse and is provided sterile. Color: ivory.	70
<b>S-Guide (VBM Medizintechnik)</b>	Single-use 15 Fr stylet, malleable, with atraumatic coude tip and hollow for oxygenation.	65
<b>Truflex Flexible Stylet (Teleflex)</b>	Reusable, stainless steel stylet. Has flexible tip with upward lift action of 30-60 degrees, depending on size of ET.	Suitable for use with ETs 6.5-8.5 mm ID
<b>VBM Introducer (VBM Medizintechnik)</b>	Single-use 15 Fr introducer with coude tip and hollow for oxygenation. Color: orange.	65
<b>VBM Tube Exchanger (VBM Medizintechnik)</b>	Single-use 11, 14, and 19 Fr tube exchanger that is hollow to allow oxygenation. Color: blue.	80

**Table 2. Stylets**

Name (Manufacturer)	Description	Size
<b>Lighted Stylets</b>		
<b>Aaron Surch-Lite (Bovie Medical Industries)</b>	10-in sterile, single-use, flexible stylet.	Adult
<b>AincA Lighted Stylet (Anesthesia Associates)</b>	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 Lighted Intubation Stylet (Medtronic)</b>	Similar to AincA lighted stylet.	Nasotracheal: 33-cm shaft Orotracheal: 25-cm shaft
<b>Vital Signs Light Wand Illuminating Stylet (GE Healthcare)</b>	Similar to AincA lighted stylet.	Adult
<b>Viewing 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>air-Vu Plus Fiber-optic Stylet (Cookgas; distributed by Mercury Medical)</b>	High-resolution, stainless steel, rigid stylet. Incorporates an adjustable tube stop and optional oxygen port for oxygen insufflation.	Adult (ETs $\geq 5.5$ mm)
<b>Ambu aScope 3 (Ambu)</b>	Single-use flexible videoscope. OD: 5.0 mm; working channel ID: 2.2 mm.	60 cm long
<b>Ambu aScope 3 Slim (Ambu)</b>	Single-use flexible videoscope. OD: 5.0 mm; working channel ID: 2.2 mm.	60 cm long

Clinical Applications	Special Features
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. Ideal for nonchanneled VL.	Malleable stylet with soft tip and oxygenation possibility (3 in 1). Unique oxygen connector included.
Using a dynamic intubation stylet eases clinical coordination difficulties associated with use of VLs by providing greater control of the ET tip direction. Also offers easy and improved laryngeal entry of ET in difficult or routine intubations.	Adjustable stopper allows use of ET tubes of differing lengths. Can be used in both direct and indirect intubations.
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.

Clinical Applications	Special Features
Usable for routine blind intubations or additional illumination during laryngoscopy, but especially useful when FOB 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).
Usable for routine intubations or video imaging during laryngoscopy, but especially useful when FOB 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.
Allows for visualization during intubation through an air-Q laryngeal mask.	Portable, durable rigid stylet that allows for a fiber-optic view during intubation through the air-Q light source. Options include GreenLine laryngoscope handle or fiber-optic light source (4 AA batteries).
Alternative to standard reusable flexible bronchoscopes. Useful for visualization during intubation through SGAs.	Fully disposable flexible scope avoids cleaning/disinfecting issues. Attaches to high-quality aView Monitor with onboard recording of video images.
Equivalent to standard reusable pediatric flexible bronchoscopes. Especially useful for positioning double-lumen endobronchial tubes or bronchial blockers.	Fully disposable flexible scope avoids cleaning/disinfecting issues. Attaches to high-quality aView Monitor with onboard recording of video images.

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**Table 2. Stylets** (continued)

Name (Manufacturer)	Description	Size
<b>Bonfils Retromolar Intubation Endoscope (KARL STORZ Endoscopy)</b>	High-resolution rigid fiber-optic stylet with a fixed 40-degree curved shape at the distal end. Available with standard eyepiece or DCI to endoscopic camera system. Can be used within C-MAC system while using the portable monitor of the C-MAC VL with C-CAM camera head.	3.5 and 5.0 mm OD; ET must be $\geq 0.5$ mm larger to fit
<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>Clarus Video System 30000V (Clarus Medical)</b>	Malleable (shapeable) rigid stylet scope with attached LCD screen and adjustable curve shape provides view from end of stylet; USB for recharging lithium ion battery and option to connect to notebook or monitor; red LED for transillumination. Assist with DL/VL or used as independent device. Also malleable for use through intubating supraglottic ventilatory devices.	5 mm OD; ETs $\geq 5.5$ mm
<b>Levitan GLS (Clarus Medical)</b>	Portable high-resolution optics from end of stylet, malleable (shapeable) rigid stainless steel stylet that protects the illumination optic fibers. Comes in preformed hockey-stick shape that can be changed, if necessary. 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 or used as independent device. 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 ID)
<b>PocketScope (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 ID)
<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 ID)
<b>Shikani Optical Stylet (SOS; Clarus Medical)</b>	Viewing stylet: high-resolution, stainless steel, malleable (shapeable) fiber-optic stylet that comes in preformed hockey-stick shape. Has adjustable tube stop and integral oxygen port for oxygen insufflation. Use to assist with DL/VL like regular stylet or used as independent device. Also malleable for use through intubating supraglottic ventilatory devices. Optional adapter uses smartphones to transform optics to video.	Adult (ETs $\geq 5.5$ mm ID) Pediatric (ETs 2.5-5.0 mm ID)

**Table 3. 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: A-360 camera and smartphone adapter.	Regular adult for ET 7.0-8.5 mm ID Small adult for ET 6.0-7.5 mm ID
<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. Both Airtraq models have an optional snap-on camera, with integrated 2.8-in touch screen that flips and rotates on 2 axes 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 available: regular adult for ET 7.0-8.5 mm ID; small adult for ET 6.0-7.5 mm ID; pediatric for ET 4.0-5.5 mm ID; infant for ET 2.5-3.5 mm ID; non-channeled blade; and double-lumen ETs
<b>Berci-Kaplan DCI Video Laryngoscope System (KARL STORZ Endoscopy)</b>	VL system with interchangeable laryngoscope blades. Platform system enables DCI camera head to snap onto any standard eyepiece fiberscopes (flexible or semirigid). Required components include camera control unit, xenon light source, and monitor. Telepack portable combination video/light source/monitor unit is also available for use with this system.	MAC 2-4; Miller 0, 1, 4; Dörge universal blade and D-Blade for difficult, very anterior airways



Clinical Applications	Special Features
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 FOB. Used with battery-powered or portable light source.
Similar to Bonfils Retromolar Intubation Fiberscope.	Available for DCI video cameras.
ET intubation, confirmation, extubation (with video); LMA placement, positioning, and intubation with certain LMAs. Provides access with limited mouth opening; malleable stylet provides shaping to reduce cervical movement.	Red LED provides better illumination than the white LED, and better transillumination when used like a light wand when use of the scope is contraindicated because of blood or vomit.
Originally designed as adjunct to DL. Many use it as a stand-alone device similar to the Shikani for intubation, cric/trach tubes, LMAs, and intubation through LMAs or just positioning or checking placement of the same.	GreenLine laryngoscope handle or a Turbo LED can be used for light sources. Very similar to the SOS, but requires user to cut the ET because it does not have a movable tube stop.
Allows for visualization during intubation through ILMA or quick confirmation of SGA, DLTs, or ET placement/positioning patency. May also be used for extubation.	Has been modified with a patented deflected tip that allows it to be used for viewing while performing nasal intubation.
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.
Similar to flexible FOB. Can be used alone or as adjunct to laryngoscopy and is especially useful for those unable to maintain skills with a bronchoscope.	Has the simple form of a standard stylet, plus the advantage of a fiber-optic view and maneuverability of its tip. Portable, rugged, and able to lift tissue. Light source options are light cable, Turbo LED, or GreenLine laryngoscope handle with adapter.

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, fiberscope guidance, tube exchange, and foreign body removal.	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.
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.	The wide-angle camera allows improved visualization and video documentation of laryngoscopy and intubation. Extreme positioning of the head is unnecessary. Blades provide 80-degree field of view.

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**Table 3. Video Laryngoscopes** (continued)

Name (Manufacturer)	Description	Size
<b>C-MAC Pocket Monitor (KARL STORZ Endoscopy)</b>	Highly portable rescue device, 2.4-in monitor fits directly on all C-MAC blades. LCD 4.3 ratio high-resolution screen works in direct sunlight; rechargeable battery lasts 1 h; ergonomic screen can be moved in several directions and folded away for transportation; fully immersible.	Same as C-MAC
<b>C-MAC Video Laryngoscope (KARL STORZ Endoscopy)</b>	Instant-on, battery-powered VL with standard shaped interchangeable MAC and Miller blades for obese adults through neonates 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 2-4, Miller 0 and 1, MAC 3 and 4 with channel for suction, D-Blade, and S-Blade (single-use); single-use blade
<b>CoPilot VL (Magaw Medical)</b>	Portable VL with an acutely angled blade and C-shaped channel for a bougie. Rechargeable lithium polymer internal battery provides >2 h of continuous use. Built-in anti-fog mechanism.	Adult sizes 3 and 4
<b>GlideScope AVL (Advanced Video Laryngoscope; Verathon)</b>	Portable advanced VL features a digital color monitor and digital camera for DVD clarity. Also includes integrated real-time recording and onboard video tutorial. Anti-fog feature to resist lens fogging. Reusable and single-use options available. With new snapshot and on-screen playback features.	6 disposable blades, sizes 0-4; reusable blades in 4 sizes: GVL 2-5
<b>GlideScope Ranger and Ranger Single Use Video Laryngoscopes (Verathon)</b>	Portable VL designed for EMS and military paramedics. Compact and rugged. Operational in seconds.	Reusable Ranger offers 2 blade sizes: 3 and 4; Ranger Single Use is offered with 6 disposable sizes: 0-4
<b>GlideScope Titanium (Verathon)</b>	GlideScope Titanium systems are available in reusable options and feature streamlined, low-profile blade designs and durable, lightweight titanium construction. Built-in anti-fog mechanism. With new snapshot and on-screen playback features.	4 reusable blade designs; LoPro 3 and 4 angled blades, and MAC-style 3 and 4 blades; compatible with full line of GlideScope AVL pediatric blades
<b>King Vision aBlade (Ambu)</b>	Reusable video adapter attaches to the existing King Vision display to allow use of lower-cost aBlades.	Same as original offering: size 3 with channeled and standard (nonchanneled) aBlade versions
<b>King Vision Video Laryngoscope (Ambu)</b>	Durable, fully portable digital VL with a high-quality reusable display and disposable blades. Display aligned with blade, ergonomic handle integrated into blade, the disposable blades incorporate the camera and light source, anti-fog coating on distal lens. Channel is soft, allowing for easy ET detachment.	One size, 2 versions, correlating to size 3 laryngoscope; channeled blade allows use of 6.0-8.0 mm ET and minimum mouth opening of 18 mm; standard blade requires minimum mouth opening of 13 mm
<b>McGrath MAC (Aircraft Medical; distributed by Medtronic)</b>	Portable VL designed for everyday use in the OR, ICU, and ED. Uses disposable MAC-shaped blades as well as acutely curved X3 Blade. Durable (drop tested up to 2 m). Screen displays minute-by-minute battery life countdown.	Blade sizes 2, 3, and 4 and X3
<b>McGrath Series 5 (Aircraft Medical)</b>	Portable VL with adjustable-length, single-use disposable blade that can be disarticulated from the handle to further assist with difficult airways. Flat-screen monitor located on the handle to remain in a more natural line of sight with patient. McGrath Series 5 HLDi is the new "High Level Disinfection Immersible" system that is entirely waterproof.	Adjusts to fit many adult and pediatric sizes
<b>Venner APA Video Laryngoscope (Venner Capital)</b>	Fully portable VL with 3.5-in monitor that attaches to a reusable handle. Self-contained LED light source. Built-in anti-fogging mechanism.	MAC 3 and 4, and Difficult Airway Blade
<b>VividTrac (Mercury Medical/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.	ET 6.0-8.5 mm

Clinical Applications	Special Features
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.
Same as DCI. Highly portable system for use in all hospital settings.	Unique platform design is compatible with multiple intubation devices, including video laryngoscopes, the F.I.V.E. distal chip flexible video scopes, and standard eye-piece 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. 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.
Same as DCI.	Patented bougie port is designed to facilitate ET placement. Single use.
DVD-quality airway view enables intubation in a wide range of adult and pediatric patients, including preterm/small child and morbidly obese, 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.
Ideal for EMS (ground and air), military, ED, ICU, and crash cart settings. Offers same benefits as AVL, GVL.	Ranger models are compact, rugged, portable, and built to military and EMS specifications. Powered by rechargeable lithium polymer battery; 1.5 lb. Awarded US Army Airworthiness and US Air Force Safe-to-Fly certifications. Reusable and disposable.
More VL options for routine and difficult airways—including new MAC-style blades—provide clinicians with a choice of airway tools for a wide range of patients, clinical settings, and teaching purposes.	Reusable blades and video cable, as well as the single-use Smart Cable, can be completely immersed in the recommended cleaning solution (IPX8 compliant). Includes anti-fog capability, plus real-time recording, display, and playback features on 6.4-in digital, color GlideScope Video Monitor.
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. Video out available for connection to external display or video-capture device.
Facilitates both routine and difficult intubations.	Can be used alone or with other techniques. Powered by 3 AAA batteries. Organic LED screen allows wide-angle viewing in various lighting conditions. Video out available for connection to external display or video-capture device.
Dual capability combines the benefits of a video-supported anterior view as well as a direct visualization to support a wide range of airways from routine to more extreme cases.	No additional training required. Supports direct and indirect visualization due to video support. Slimline blade for improved agility. Blade shape requires less tube curvature than other VLs for easier insertion and a stylet is not always required. Highly portable and lightweight. No electrical outlet required, thus ideal for settings outside the OR. Uses disposable blades for quick turnaround between uses and for limiting cross-contamination. Monitor located on the handle to remain in a more natural line. Waterproof.
Useful in patients with limited mouth opening or head and neck movement, anterior airways; obese patients; patients in whom an increased hemodynamic response is a concern; and for teaching.	Highly portable and lightweight. Uses disposable blades for quick turnaround between uses and for limiting cross-contamination. Adjustable blade allows use of different blade lengths on the spot. Low-profile blade and disarticulating handle can accommodate patients with very limited mouth opening and severely limited movement of the head and neck. Monitor is located on the handle to remain in a more natural line of sight with the patient.
Similar to C-MAC VL.	Can be used as traditional laryngoscope and converted to VL by attachment of monitor.
Intended to facilitate intubation in both routine and difficult airway situations.	VividTrac is inserted more like an oral airway device (or LMA) than a laryngoscope blade. The ET can be preloaded or inserted once visualization is achieved in the VividTrac tube channel.

**Table 4. Indirect Rigid Fiber-Optic 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 Miller 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 Prisms (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

**Table 5. Supraglottic Ventilatory Devices**

Name (Manufacturer)	Description	Size
<b>AES The Guardian CPV (AES)</b>	All-silicone laryngeal mask with a vented gastric tube and CPV that constantly monitors cuff pressure.	Adult sizes 3, 4, 5
<b>AES Ultra (AES)</b>	All-silicone laryngeal mask with standard cuff valve.	Adult sizes 3, 4, 5, 6
<b>AES Ultra Clear (AES)</b>	Silicone cuff and PVC tube, laryngeal mask with standard cuff valve.	Adult sizes 3, 4, 5, 6
<b>AES Ultra Clear CPV (AES)</b>	Silicone cuff and PVC tube, laryngeal mask with CPV that constantly monitors cuff pressures.	Pediatric to adult sizes 1, 1.5, 2, 2.5, 3, 4, 5, 6
<b>AES Ultra CPV (AES)</b>	All-silicone laryngeal mask with CPV that constantly monitors cuff pressures.	Pediatric to adult sizes 1, 1.5, 2, 2.5, 3, 4, 5, 6
<b>AES Ultra EX (AES; distributed by Anesthesia Associates)</b>	All-silicone, multiple-use laryngeal mask.	Pediatric to adult sizes 1, 1.5, 2, 2.5, 3, 4, 5, 6
<b>AES Ultra Flex CPV (AES)</b>	Wire-reinforced, silicone cuff and tube with CPV that constantly monitors pressure changes in the cuff.	Pediatric to adult sizes 1, 1.5, 2, 2.5, 3, 4, 5, 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, 1.5, 2, 2.5, 3, 4, 5, 6
<b>air-Q Blocker (Cookgas; distributed by Mercury Medical)</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

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.

Clinical Applications	Special Features
SGA with built-in CPV to minimize postoperative sore throat. Color indicator bands provide instant feedback regarding pressure changes.	The CPV detects changes caused by temperature, nitrous oxide levels, and movement within the airway, enabling clinician to maintain a recommended cuff pressure of 60 cm H <sub>2</sub> O. Single use.
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.
Similar to AES Ultra CPV.	Similar to AES Ultra CPV.
SGA with built-in CPV to minimize postoperative sore throat. Color indicator bands provide instant feedback regarding pressure changes.	The CPV detects changes caused by temperature, nitrous oxide levels, and movement within the airway, enabling clinician to maintain a recommended cuff pressure of 60 cm H <sub>2</sub> O. Single use.
Reusable, standard SGA.	40 uses.
Wire-reinforced SGA that accommodates repositioning of the head and neck. Color indicator bands provide instant feedback regarding pressure changes.	Single use. The cuff pressure indicator detects changes caused by temperature, nitrous oxide levels, and movement within the airway. The CPV enables the clinician to maintain a recommended cuff pressure of 60 cm H <sub>2</sub> O.
Reusable, wire-reinforced SGA, designed to accommodate repositioning of the head and neck during surgery.	40 uses.
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 ≤8.5 mm.

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**Table 5. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>air-Q</b> (Cookgas; distributed by Mercury Medical)	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 Disposable</b> (Cookgas; distributed by Mercury Medical)	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
<b>air-Q SP</b> (Cookgas; distributed by Mercury Medical)	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</b> (Cookgas; distributed by Mercury Medical)	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 ET tubes ≤8.5 mm
<b>Ambu AuraFlex</b> (Ambu)	Disposable wire-reinforced flexible LMA.	Adult and pediatric sizes 2-6
<b>Ambu AuraGain</b> (Ambu)	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.	Adult sizes 3-5
<b>Ambu Aura-i</b> (Ambu)	A laryngeal mask with built-in curve and bite blocker designed as a conduit for optical endotracheal intubation.	Adult and pediatric sizes 1-6
<b>Ambu AuraOnce</b> (Ambu)	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.	Adult and pediatric sizes 1-6
<b>Ambu AuraStraight</b> (Ambu)	Similar to the LMA Unique but without epiglottic bars on the anterior surface of the cuff.	Adult and pediatric sizes 1-6
<b>Ambu Aura40</b> (Ambu)	Same design as the Ambu AuraOnce, but reusable.	Adult and pediatric sizes 1-6
<b>Ambu Aura40 Straight</b> (Ambu)	Similar to LMA Classic. No epiglottic bars on anterior surface of the cuff.	Adult and pediatric sizes 1-6
<b>CobraPLA</b> (Pulmonary)	Large ID LT, which is soft and flexible with a tapered, striated tip. Now has improved distal curve, softer tube, and softer head. It has a high-volume, low-pressure oropharyngeal cuff.	Adult and pediatric sizes 0.5-6
<b>CobraPLUS</b> (Pulmonary)	Similar to the CobraPLA. Includes temperature monitor and distal gas sampling in all sizes.	Adult and pediatric sizes 0.5-6
<b>Combitube</b> (Medtronic)	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>i-gel</b> (Intersurgical)	SGA with a noninflating cuff, designed to mirror the anatomy over the laryngeal inlet, 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 fiber-optic guidance (sizes 3, 4, and 5).	Adult sizes 3-5 and pediatric sizes 1-2.5; adult sizes accommodate ET sizes 6.0-8.0 mm

Clinical Applications	Special Features
Similar to both LMA Classic and LMA Fastrach. Allows easy access for flexible fiber-optic 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.
Same as air-Q Reusable Laryngeal Mask.	Removable color-coded connector allows intubation with standard ETs $\leq 8.5$ mm.
More secure than a face mask and less invasive than intubation with an ET when tracheal intubation 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.
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; gastric access channel $\leq 14$ Fr tube.
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 flexible fiber-optic 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 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.
Routine use of SGA.	Reusable.
Routine use of SGA.	Reusable. Available only in US.
Routine use of SGA.	Disposable. If intubation becomes necessary or desired, will accommodate ET $\leq 8.0$ mm. Single use.
Routine use of SGA. Added benefit: able to measure core temperature. Distal CO <sub>2</sub> can be monitored in pediatric patients.	Similar to CobraPLA, but allows monitoring of patient's core temperature. In neonatal and infant patients, has ability to increase the accuracy of end-tidal CO <sub>2</sub> and volatile gas analysis. If intubation necessary or desired, will accommodate ET $\leq 8.0$ mm. Single use.
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 oro-gastric tube when placed in the esophagus. Single use.
Indicated for use in routine and emergency anesthesia and resuscitation in adult patients. i-gel is not indicated for use in resuscitation in children. Can be used as a conduit for intubation with fiber-optic guidance (sizes 3, 4, and 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).	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 fiber-optic guidance (sizes 3, 4, and 5).

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**Table 5. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>i-gel O<sub>2</sub> Resus Pack (Intersurgical)</b>	SGA with a supplementary oxygen port, an integral color-coded hook ring to secure airway support strap and identify size; designed to facilitate ventilation. Includes noninflating cuff to mirror anatomy, with an integral bite block, buccal cavity stabilizer, and gastric channel. The pack contains an i-gel O <sub>2</sub> second-generation SGA, a sachet of lubricant, and an airway support strap.	Adult sizes 3-5; adult sizes accommodate ET sizes 6.0-8.0 mm
<b>KING LT (Ambu)</b>	Multiuse, latex-free, single-lumen silicone tube with oropharyngeal and esophageal low-pressure cuffs, 2 ventilation outlets, insertion marks, and a blind distal tip (almost like a single-lumen, shortened Combitube). Color-coded connectors for each size.	Sizes 0-5
<b>KING LT-D (Ambu)</b>	Same design as the KING LT, except disposable.	Adult sizes 3-5 and pediatric sizes 2, 2.5
<b>KING LTS (Ambu)</b>	Double-lumen LT that incorporates a second (esophageal) lumen posterior to the ventilation lumen.	Adult sizes 3-5 and pediatric sizes 0, 1, 2, 2.5
<b>KING LTS-D (Ambu)</b>	Same as KING LTS, except disposable.	Adult sizes 3-5
<b>LMA Classic (Teleflex)</b>	Safe, general-purpose airway for routine elective inpatient and outpatient surgical procedures.	Adult sizes 3, 4, 5, 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, 4, 5, 6 and pediatric sizes 2, 2.5
<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, 4, 5 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Protector Cuff Pilot (Teleflex)</b>	Second-generation SGA device that is all silicone and has integrated Cuff Pilot. 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 regurgitation and allows for diagnostic positioning.	Adult sizes 3-5
<b>LMA Supreme (Teleflex)</b>	Combines features of all 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, 4, 5 and pediatric sizes 1, 1.5, 2, 2.5
<b>LMA Unique EVO (Teleflex)</b>	Silicone cuffed LMA that also offers ET intubation capabilities.	Adult sizes 3-5
<b>LMA Unique with Cuff Pilot Technology (Teleflex)</b>	Original, disposable LMA design and has integrated Cuff Pilot. Sterile, latex-free, available with or without syringe and lubricant. Soft cuff and airway tube allow for conformity to patients' natural anatomy.	Adult and pediatric sizes 1-5



Clinical Applications	Special Features
Indicated for use in routine and emergency anesthesia and resuscitation in adult patients. Can be used as a conduit for intubation with fiber-optic 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.	Noninflating cuff allows easy and rapid insertion, provides high seal pressure, and minimizes risk for tissue compression. Supplementary oxygen port allows for administration of passive oxygenation as a component of cardio-cerebral resuscitation. 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 fiber-optic guidance.
Reusable SGA but with ventilator seal characteristics.	Easily inserted, possible aspiration protection, and allows both PPV and spontaneous breathing. Reusable (≤50 times).
Same as KING LT.	Also available in a kit. Single use.
Same as KING LT, except that it has a second lumen for gastric access, similar to LMA ProSeal.	Allows easy passage of a gastric tube to evacuate stomach contents. Distal tip reduced in size to facilitate insertion. Reusable.
Same as KING LTS.	Allows passage of 18 Fr gastric tube. Also available in a kit.
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 endotracheal 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.	May be used ≤40 times before discarding.
Improves on features of the original LMA Classic Airway, facilitating intubation, and is reusable ≤60 times.	Removable connector and epiglottic elevating bar to facilitate intubation. Works with ET ≤7.5 mm. Reusable ≤60 times.
Designed for anatomically difficult airway and included in AHA's and ASA's difficult airway algorithms.	Supplied in a sterile version for single-use only, as well as in a nonsterile reusable version, which may be used ≤40 times before discarding.
Ideal for ENT, ophthalmic, and dental surgery, or other procedures where the surgeon and anesthesiologist compete for airway access.	Supplied in a sterile version for single use only, as well as in a nonsterile reusable version that may be used ≤40 times before discarding.
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. Reusable.
For routine procedures or to manage high-risk patients.	Cuff Pilot allows for continual display of pressure within airway cuff, helping to reduce the incidence of excessive cuff pressure. Airway channel allows for fiberoptically aided intubation through the device. Gastric channel allows for the removal of regurgitated gastric contents. Silicone cuff is designed to be gentle to the anatomy.
For routine procedures or to manage higher-risk patients.	Allows for easy insertion, higher seal pressures, and provides gastric access to suction or to 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.
Enhanced design is ideal for unforeseen airway complications where intubation becomes necessary, and the silicone cuff is designed to be gentle to the anatomy.	LMA Unique EVO Airway also features Cuff Pilot Technology, an integrated cuff pressure indicator that provides constant at-a-glance feedback, alerting clinicians to changes in cuff pressure.
Same as LMA Classic. Included in AHA 2000 Guidelines for CPR and Emergency Medicine Cardiovascular Care.	Single use. Cuff Pilot.

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**Table 5. Supraglottic Ventilatory Devices** (continued)

Name (Manufacturer)	Description	Size
<b>Rüsch Easy Tube (Teleflex)</b>	Disposable LT that combines the features of a conventional ET with those of an esophageal obturator airway similar in design to the Combitube.	Small, 28 Fr; large, 41 Fr
<b>Soft-Seal (Smiths Medical)</b>	Similar in shape to the LMA Unique, 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.	Adult and pediatric sizes 1-5
<b>Solus Satin (Intersurgical)</b>	A range of single-use, latex-free LMAs with a softer airway tube to provide more flexibility.	Adult sizes 3-5
<b>Solus Standard (Intersurgical)</b>	A range of single-use, latex-free LMAs.	Adult sizes 3-5 and pediatric sizes 1-2.5

**Table 6. Devices for Special Airway Techniques**

Name (Manufacturer)	Description	Size
<b>Awake Intubation</b>		
<b>DeVilbiss Model 15 Medical 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>Enk Fiberoptic Atomizer Set (Cook Medical)</b>	Device for atomizing small doses of local anesthetics. Atomizer set consists of a pressure-resistant oxygen tube and a connecting tube attached by a 3-way side-arm fitting with a small flow control opening. The set also contains an introducer catheter and 2 syringes (1 mL).	
<b>EZ-Spray (Alcove Medical)</b>	Disposable atomizer device that comprises a plastic receptacle, atomizer nozzle, and gas inlet tube. Tubing is connected from an air or oxygen flowmeter nipple to the gas inlet tube on the device.	
<b>LMA MADdy Pediatric Mucosal Atomization Device (Teleflex)</b>	Delivers intranasal/intraoral medications in a fine mist that enhances absorption and improves bioavailability for fast and effective drug delivery.	Typical particle size: 30 microns; system dead space: 0.12 mL (with syringe), 0.07 mL (device only); tip diameter: 0.19 in (4.8 mm); applicator length: 4.5 in (11.4 cm)
<b>LMA MADgic Airway Intubating Airway with Mucosal Atomization and Oxygen Delivery (Teleflex)</b>	For difficult and awake airways requiring a fiber-optic scope, the device combines atomized topical anesthetic and oxygen delivery in an innovative and elegantly designed fiber-optic-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 (6.5-8.0 ET)

Clinical Applications	Special Features
Same as Esophageal Tracheal Combitube.	Similar to Combitube with following differences: single lumen at distal tip, soft latex-free cuff, open proximal second lumen allows use of fiber-optic device or passage of a suction catheter or tube exchanger. Single use.
Same as LMA Classic. Allows easy access for flexible fiber-optic devices.	If intubation necessary or desired, will accommodate ET up to 7.5 mm. Single use.
Indicated for use in anesthesia and emergency medicine. Single-use LMA, 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. Has a softer airway tube to provide more flexibility. Clear, pliable airway tube allows for early detection of rising fluids. Cuff size indicators are accurately aligned and prominently displayed at top of tube and on pilot balloon. Essential user information on exposed section of airway tube for quick visual reference.
Indicated for use in anesthesia and emergency medicine. Single-use LMA, 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. Clear, pliable airway tube allows for early detection of rising fluids. Cuff size indicators are accurately aligned and prominently displayed at top of tube and on pilot balloon. Essential user information on exposed section of airway tube for quick visual reference.

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.
To apply topical anesthetics to laryngotracheal area through the working channel of a bronchoscope using oxygen flow. Designed and intended for use by those trained and experienced in techniques of flexible fiber-optic intubation.	An accessory to a bronchoscope. Delivery form: fine spray mist using oxygen flow through the working channel bronchoscope. Sterile. Single use.
Application of topical anesthetic to the nose, oropharynx, and upper airway of patients, at the direction/discretion of a clinician.	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.
Application of topical anesthetics to oropharynx and upper airway region. Fits through vocal cords, down LMA, or into nasal cavity.	Child-friendly and no sharps (bright colors in a toylike presentation make procedure less scary for young patients). Flexible (internal stylet provides support, malleability, and memory). Disposable (single-patient use eliminates risk for cross-contamination). Practitioner-controlled (patient needs targeted specially by medication, concentration, position, and location).
For use with FOB.	Intubating airway with mucosal atomization and oxygen delivery.

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**Table 6. Devices for Special Airway Techniques** (continued)

Name (Manufacturer)	Description	Size
<b>LMA MADgic Laryngo-Tracheal Atomizer</b> (Teleflex)	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 MADgicWand Mucosal Atomization Device</b> (Teleflex)	Combines atomized topical anesthesia and oxygen delivery in a fiber-optic oral airway. Packaged in box of 20.	Typical particle size: 30-100 microns; system dead space: 0.25 mL
<b>LMA MAD Nasal-Intranasal Mucosal Atomization Device</b> (Teleflex)	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>Retrograde Intubation</b>		
<b>Cook Retrograde Intubation Set</b> (Cook Medical)	Available as a complete set in 6.0, 11, or 14 F. The 14 F version includes Airway Exchange Catheter with Rapi-Fit adapters allow for delivery of oxygen.	6.0 F=50 cm; 14 F=60 cm, extra-stiff floppy tipped guidewire = 110 cm
<b>Face Mask Ventilation and Nasal Oxygenation</b>		
<b>Endoscopy Mask</b> (VBM Medizintechnik)	Face mask with diaphragm to allow simultaneous ventilation and endoscopy.	Newborn, infant, child, and adult
<b>Flow-Safe II CPAP System</b> (Mercury Medical)	Disposable CPAP with deluxe mask and comfortable head harness, color-coded manometer for verifying CPAP pressure and pressure-relief system. Flow-Safe II works with standard flowmeters that can deliver >10 cm H <sub>2</sub> O at 15 L/min. Accepts standard nebulizers and standard CO <sub>2</sub> sampling lines.	Child, small adult, and large adult
<b>Flow-Safe II EZ CPAP System</b> (Mercury Medical)	Disposable CPAP similar to Flow-Safe II that also includes an integrated nebulizer. The system 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
<b>Optiflow Nasal Cannula</b> (Fisher & Paykel Healthcare)	Nasal cannulae humidification system with customizable head strap and soft cheek pads. System includes heated inspiratory tubing and chamber.	Small, medium, and large (20 per box)
<b>Super NO2VA</b> (Revolutionary Medical Devices)	Nasal oxygenating and ventilating apparatus that provides noninvasive positive-pressure nasal ventilation. An attachable mouthpiece provides full face mask ventilation.	One size

Clinical Applications	Special Features
Application of topical anesthetics to oropharynx and upper airway region. Fits through vocal cords, down LMA, 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.
Allows retraction of soft tissue while applying topical anesthesia in a fine, gentle mist. Used to apply topical anesthetic to the airway before awake intubation.	Device blade positioned along floor of the mouth can be directed immediately in front of laryngeal inlet to generate a fine mist by a piston syringe. 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).
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; 14 Fr places tubes $\geq 5$ 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.
<ul style="list-style-type: none"> <li>• Fiber-optic intubation</li> <li>• Airway endoscopy</li> <li>• Gastroenterology</li> <li>• Transesophageal echocardiography</li> </ul>	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.
Built-in manometer for verified pressure readings. No assembly of separate apparatus and the pressure-relief valve automatically adjusts to avoid excess pressure.	Lighter, easier to handle, and designed to form a better 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.
Allows heated humidification of nasal high-flow oxygen therapy. May be used in patients with hypoxemic respiratory failure, prior to and during induction of general anesthesia or as an adjunct during moderate-deep sedation. May also be used to wean patients off of Bilevel Positive Airway Pressure or CPAP.	Customizable alternative to humidified face mask oxygen therapy, provides comfortable and effective noninvasive high flow oxygen therapy up to 70 L/min.
Allows oxygenation and ventilation both prior to and during intubation procedure, as well as intraoperatively as nasal CPAP and postoperatively as supplemental oxygen delivery apparatus.	Alternative to traditional face mask. Nasal mask may be beneficial for patients with facial hair and high body mass index.

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**Table 6. Devices for Special Airway Techniques** (continued)

Name (Manufacturer)	Description	Size
<b>Transtracheal Jet Ventilation</b>		
<b>AincA Manual Jet Ventilator (Anesthesia Associates)</b>	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 Manual Jet Ventilator (Anesthesia Associates)</b>	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>Enk Oxygen Flow Modulator Set (Cook Medical)</b>	Complete set including 15-G needle with reinforced fluorinated ethylene propylene catheter, syringe (5 cc), connecting tubing, and Enk oxygen flow modulator with tracheal catheter connector.	7.5 cm (2.0 mm ID)
<b>Manual Jet Ventilator (Instrumentation Industries)</b>	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 (VBM Medizintechnik)</b>	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 Trio (Pulmodyne)</b>	Emergency disposable CPAP device.	3 - FiO <sub>2</sub> levels 3 - PEEP settings BiTrac ED Mask
<b>Trans-tracheal Catheter (Acutronic Medical System)</b>	Small jet needle for puncturing the trachea in an emergency for use with jet ventilation.	13 G, 14 G
<b>Ventrain (Ventiv Medical B.V.)</b>	Available as a separate device or as a kit with Cricath. Has an additional male luer connector for connection to measure CO <sub>2</sub> levels.	2-mm cric catheter suitable for all patients

**Table 7. Positioning Devices**

Name (Manufacturer)	Description
<b>Air-SPACE Air Sniffing Position and Chin Elevation Device (Revolutionary Medical Devices)</b>	Mechanized positioning device optimizes airway axis alignment during laryngoscopy. Includes foam head support ring, 15-degree wedge, and disposable sheet.
<b>Chin-UP (Dupaco; distributed by Mercury Medical)</b>	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 (Mercury Medical)</b>	Fully adjustable cushion set accommodates most adult head sizes.
<b>RAMP Rapid Airway Management Positioner (Airpal Patient Transfer Systems)</b>	Air-assisted medical device that can be inflated to transfer and position patients for various procedures.
<b>Troop Elevation Pillow (Mercury Medical)</b>	Foam positioning device that quickly achieves the head elevated laryngoscopy position. Includes many accessories (head cradle, arm board pads, additional pillow).

Clinical Applications	Special Features
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.
Similar to the AincA Manual Jet Ventilator. Recommended for use when jet ventilation is appropriate but not available.	Packaged as complete set with everything needed to perform TTJV. Disposable.
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. Allows dial-in FIO <sub>2</sub> levels of ~30%, 60%, and 90%. Constant flow obtained regardless of the amount of oxygen in the tank.	Disposable CPAP generator with ≤21 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.
Provides full ventilation in cannot-intubate, cannot-ventilate situations.	Not only supplies oxygen during the inspiration phase but also uses suction to actively remove gas from the lungs during the expiration phase.

Clinical Applications	Special Features
Incorporates 3 clinically recommended positions to optimize patient positioning during airway management (ventilation, laryngoscopy, and intubation). Intended for use in multiple anesthetic populations, including the morbidly obese.	The device is mounted to the operating table and allows patient positioning by mechanical adjustments to achieve optimal head and neck position of the patient.
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.
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, and facilitating mask ventilation, laryngoscopy, DL, and central venous access. Allows patients to breathe more comfortably during preoxygenation and regional anesthesia.	Available in disposable and reusable formats. Troop Elevation Pillow may be added for super morbidly obese patients.

**Table 8. Cricothyrotomy Devices**

Name (Manufacturer)	Description	Size
<b>Needle Cricothyrotomy</b>		
<b>Emergency Transtracheal Airway Catheter (Cook Medical)</b>	6 Fr reinforced fluorinated ethylene propylene catheter.	5.0 and 7.5 cm
<b>Percutaneous Cricothyrotomy</b>		
<b>Melker Emergency Cricothyrotomy Catheter Set (Cook Medical)</b>	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 (Pulmonary)</b>	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 Emergency Cricothyrotomy Device (VBM Medizintechnik)</b>	Complete kit includes airway catheter, stopper, needle, and syringes that come preassembled.	Adult (4 mm ID) Child (2 mm ID)
<b>Surgical Cricothyrotomy</b>		
<b>Melker Surgical Cricothyrotomy Set (Cook Medical)</b>	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 Emergency Cricothyrotomy Catheter Set (Cook Medical)</b>	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 (Teleflex)</b>	Complete Seldinger-based cricothyrotomy set, premounted EasyCric tube and dilator (hydrophilic coated, anatomically shaped).	Adult (size 5)
<b>Surgicric (VBM Medizintechnik)</b>	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
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. 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 fiber-optic bronchoscopy. Immediate airway control in patients with maxillofacial, cervical spine, head, neck, and multiple trauma. Also used when endotracheal 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.
Same as Melker Emergency Cricothyrotomy Catheter Set.	Packaged as complete kit with everything needed to perform a percutaneous cricothyrotomy—even the neck tape and connecting tube. 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. Disposable.
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 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.
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 9. Tracheostomy Devices**

Name (Manufacturer)	Description	Size
<b>Percutaneous Dilatational Tracheostomy</b>		
<b>Blom Tracheostomy Tubes (Pulmonary)</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 Dolphin Balloon Percutaneous Tracheostomy Introducer (Cook Medical)</b>	Complete kit with size-specific Blue Dolphin balloon dilator. Available with or without Shiley 6 or 8 percutaneous tracheostomy tubes. Tray version is available that includes lidocaine/epinephrine, 15-mm swivel connector, chlorhexidine skin prep, drape, and suture.	21, 24, 26, 27, 28, 30 Fr introducers
<b>Ciaglia Blue Rhino Percutaneous Introducer Set (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 Dilatational 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 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><b>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.</b></p>		

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.
One-step dilation and tracheal tube insertion. Establishes transcutaneous access to the trachea below the level of the cricoid cartilage by Seldinger technique.	Unique balloon-tipped design dilatation and tracheal tube insertion in 1 step. Packaged as a complete kit with everything needed to perform a percutaneous dilatational tracheostomy.
Same as Portex Ultraperc Percutaneous Dilatation Tracheostomy Kit.	Packaged as a complete kit with everything needed to perform a percutaneous dilatational tracheostomy. The single dilator with a hydrophilic coating and flexible tip results in a simpler, less traumatic insertion. The wire guide has a Safe-T-J tip 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.
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.

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## Abbreviation Key

<b>AEC</b>	airway exchange catheter	<b>EMS</b>	emergency medical services	<b>MRI</b>	magnetic resonance imaging
<b>AHA</b>	American Heart Association	<b>ENT</b>	ear, nose, and throat	<b>NGT</b>	nasogastric tube
<b>ARDS</b>	acute respiratory distress syndrome	<b>ET</b>	endotracheal tube	<b>NICU</b>	neonatal intensive care unit
<b>ASA</b>	American Society of Anesthesiologists	<b>FiO<sub>2</sub></b>	fraction of inspired oxygen	<b>NTSC</b>	National Television System Committee
<b>CCD</b>	charge-coupled device	<b>FOB</b>	fiber-optic bronchoscope	<b>OD</b>	outer diameter
<b>CMOS</b>	complementary metal oxide semiconductor	<b>Fr</b>	French	<b>OR</b>	operating room
<b>CPAP</b>	continuous positive airway pressure	<b>ID</b>	internal diameter	<b>PEEP</b>	positive end-expiratory pressure
<b>CPR</b>	cardiopulmonary resuscitation	<b>ILMA</b>	intubating laryngeal mask airway	<b>PPV</b>	positive-pressure ventilation
<b>CPV</b>	Cuff Pilot valve	<b>ISO</b>	International Organization for Standardization	<b>PVC</b>	polyvinyl chloride
<b>DCI</b>	direct-coupled interface	<b>LCD</b>	liquid crystal display	<b>PVP</b>	polyvinylpyrrolidone
<b>DISS</b>	diameter index safety system	<b>LED</b>	light-emitting diode	<b>SGA</b>	supraglottic airway
<b>DL</b>	direct laryngoscopy	<b>LMA</b>	laryngeal mask airway	<b>Stat</b>	sterile single-use blade
<b>DLT</b>	double-lumen tube	<b>LT</b>	laryngeal tube	<b>TFE</b>	tetrafluoroethylene
<b>ED</b>	emergency department	<b>LTA</b>	laryngeal tracheal anesthesia	<b>TTJV</b>	transtracheal jet ventilation
<b>EF</b>	extra firm	<b>MAC</b>	Macintosh	<b>USB</b>	universal serial bus
				<b>VL</b>	video laryngoscope/laryngoscopy