# Supraglottic Airways For Pediatric Patients:
## An Overview

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A supraglottic or extraglottic airway (SGA/EGA) is any device that sits outside the larynx and forms a seal around it. Laryngeal masks represent a subset of these devices. Laryngeal masks have evolved since Dr. Archie Brain's prototype of the early 1980s. These changes have expanded the indications for their use. Once used solely to replace the facemask (FM) with spontaneous ventilation, laryngeal masks now often are used as substitutes for the tracheal tube (TT) and to deliver positive pressure ventilation (PPV).

The airway is in transition as children grow. The larynx starts high in the neck and slowly descends, the pharyngeal space increases, the orientation of the vocal cords changes, the prominence of the occiput decreases, and oxygen consumption decreases. This transitional anatomy is most relevant from the neonatal period to about age 2 years, and therefore significantly affects the use of laryngeal masks in this age range.

The original laryngeal mask, the laryngeal mask airway (LMA, Teleflex) has been studied extensively in children. A few general conclusions may be made:

- It allows adequate oxygenation and ventilation in the vast majority of children and is the ideal rescue device for failed facemask ventilation (FMV).
- It may facilitate neonatal resuscitation.
- It serves as an ideal conduit for fiber-optic tracheal intubation; however, children who require masks smaller than size 3 require additional maneuvers when a cuffed TT is used.
- Airway problems more likely in infants include poor sealing, movement and dislodgement of the mask, compression of glottic structures, reflex activation of the airway, and gastric insufflation.
- Technical difficulties with laryngeal masks increase with decreasing age. Newer laryngeal masks have design features to help reduce technical problems. These include stiffer mask bowls to reduce folding of the mask tip, shorter, wider airway tubes to facilitate tracheal intubation, gastric access channels to evacuate gastric contents and air, and to confirm adequate position of the leading edge of the device.

## Classification of Devices

SGAs are classified as first- or second-generation devices.[1] First-generation devices are airway tubes attached to a mask, whereas second-generation devices incorporate a gastric access channel. When adequately placed, the leading edge of the SGA sits in the upper esophagus, creating a "second seal" or hypopharyngeal seal. Second-generation devices (LMA ProSeal, LMA Supreme, i-gel [Intersurgical]) typically provide a better second seal and allow gastric contents to be evacuated. This feature facilitates more effective PPV. Several new SGAs are available for pediatric use. Clinicians must familiarize themselves with the unique design features, advantages, limitations, and the evidence supporting the use of these devices.

## Upper Respiratory Tract Infections

Children with upper respiratory infections (URIs) can be safely managed with a laryngeal mask. In one study of 82 patients with acute uncomplicated URIs, patients were randomly assigned to receive either the LMA or a TT. The authors found a higher incidence of respiratory complications in the TT group.[1] In another study, the LMA was compared with the FM for providing anesthesia in 150 children with URIs. The incidence of coughing, vomiting, and airway interventions were higher in the FM group.[2] A prospective study of 1,996 children compared the frequency of perioperative airway complications with the LMA, FM, and TT. The authors identified 3 risk factors for airway complications: the presence of a respiratory infection; age less than 6 years; and use of the LMA.

Children with URIs often have a higher incidence of perioperative complications such as cough, laryngospasm, bronchospasm, obstruction, and desaturation. Some published literature supports the use of laryngeal masks in these patients,[1] however, other studies have reported a greater incidence of adverse events (AEs) with these devices.[3,4] The decision to use a laryngeal mask in these patients should be based on patient factors, such as age, provider factors (eg, clinician experience with the selected device), and surgical factors (eg, duration of the procedure).

## Concepts and Principles For Airway Management

Airway leak pressure is a surrogate marker for seal of the SGA. Leak pressure can be determined by auscultating the anterior neck with the pop-off valve closed while maintaining a constant fresh gas flow of 3 to 5 L per minute.[2] The point at which the manometer reaches equilibrium indicates the leak pressure. The hypoharyngeal seal can be assessed by auscultating over the epigastrium during leak pressure testing. If PPV is used, pressures should be maintained below the pressure at which gastric insufflation is detected when testing for leakage. Because of the ability to empty the stomach, a second-generation device is preferred when PPV is required.[1,3-8]

Children often have high lung compliance.[9] Consequently, the peak airway pressure needed to achieve adequate tidal volumes under anesthesia often is less than for adults.

Optimal positioning and seal of an SGA has been traditionally guided by clinical end points such as outward movement of the SGA upon cuff inflation. However using clinical end points alone may result in significant hyperinflation of the cuff.[10] Reducing the intracuff pressure to 40 cm $H_2O$ has been shown to improve airway seal.[11,12] This effect results from better molding of the cuff around the airway. Therefore, titrating cuff pressure to the lowest necessary is important for the safe and effective use of these devices.

There is little correlation between the anatomic position and function of SGAs.[13-15] Downfolding of the epiglottis is often seen during fiber-optic inspection of the larynx using SGAs that are well functioning as assessed by ventilatory parameters.[16,17] Because of the variable rates of epiglottic downfolding reported in the literature,[14,15,17,18] blind intubations through SGAs should be performed as a last resort to avoid laryngeal trauma or esophageal intubation. Techniques that allow visualization should be used when intubating through a SGA.[19]

## Second-Generation Devices

The prototypical second-generation device is the LMA ProSeal, which is associated with a long history

of safety and efficacy for various procedures in children.[1,20] Newer second-generation devices include the LMA Supreme and the i-gel.

### *LMA Supreme*

The LMA Supreme is a single-use, curved laryngeal mask with features similar to both the LMA ProSeal (gastric access) and the LMA Fastrach (curved-rigid airway). The Supreme consists of an elliptical airway tube and an integrated drain tube that is positioned in the center of the airway tube and exits in the center of the mask bowl. The proximal end of the airway tube consists of a bite block, which should lie between the teeth when the mask is properly positioned. A fixation tab allows the mask to be secured to the face. However, in children, one study reported a more stable fixation of this device with tape around the airway tube as performed with traditional SGAs (Figure 1).[21]

Before insertion, the device is fully deflated and the patient is placed in the "sniffing" position. The device is inserted into the mouth in a slightly diagonal fashion while maintaining pressure against the palate. The laryngeal mask is then rotated inward and advanced into the hypopharynx until resistance is felt.[22] An appropriately positioned mask forms a perilaryngeal seal, and the leading edge of the device is within the upper esophageal sphincter.

A simple way to confirm the position of the mask is the suprasternal notch test. A small amount of water-soluble lubricant is applied to the drain tube of the device. Application of slight pressure in the suprasternal notch should result in a slight up-and-down movement of the applied lubricant on the drain tube. This confirms that the drain tube is contiguous with the upper esophageal sphincter. The ability to easily place a gastric tube through the drain tube further confirms correct positioning of the airway, and studies support that gastric tube placement is straightforward and easy.[5,21,23,24]

The LMA Supreme is available in all pediatric sizes. A study comparing the LMA Supreme with the LMA Proseal and the Classic LMA in a neonatal manikin model demonstrated higher inflation pressures and shorter insertion times with the LMA Supreme.[25] Several randomized controlled trials have been performed comparing the LMA Supreme with the LMA Unique and i-gel (Table 1). These studies demonstrate that the LMA Supreme is associated with similar or higher airway leak pressures than the LMA Unique, with the added advantage of gastric access.[4,23] In addition, the hypopharyngeal seal offered by the LMA Supreme is superior to that of the LMA Unique, as evidenced by lower rates of gastric insufflation during leak pressure testing.[4,23] The LMA Supreme also was shown to have a lower airway leak pressure than the i-gel.[5] although clinical performance, including PPV, was similar with the 2 devices. An intracuff pressure of 40 cm $H_2O$ may be as effective as an intracuff pressure of 60 cm $H_2O$ for the pediatric Supreme.[23]

### *I-gel*

The i-gel is a single-use second-generation supraglottic device that consists of a noninflatable laryngeal mask made from a gel-like thermoplastic elastomer. It has a built-in bite block and a gastric access channel.

## Case 1.

**A healthy 5-year-old boy (20 kg) presented for inguinal herniorrhaphy. After inhaled induction with sevoflurane in nitrous oxide and oxygen, a peripheral IV catheter was placed. Under deep inhaled anesthesia, a size 2.5 LMA Supreme was placed in the boy's pharynx in the standard fashion. The fixation tab of the mask was noted to be at the level of the upper lip. The mask was secured in the standard fashion (Figure 1).**

**A small amount of water-soluble lubricant was placed on the orifice of the drain tube. Gentle compression in the suprasternal notch confirmed slight bowing in and out of the lubricant. Ventilation through the airway tube did not result in expulsion of the lubricant jelly. Auscultation of the epigastrium during PPV did not reveal gastric insufflation.**

**A nasogastric tube was inserted easily into the drain tube and placed on low continuous suction. The case proceeded uneventfully and the LMA Supreme was removed under deep anesthesia at the conclusion of the surgery.**

**In this case, the LMA Supreme position was confirmed by the tests performed. The bowing of the gel with compression of the suprasternal notch confirmed that the tip of the mask was contiguous with the esophagus. The lack of expulsion of the lubricant gel during PPV and auscultating over the epigastrium during PPV confirmed that there was no air leak into the gastrointestinal system.**

**Figure 1.** Size 2 LMA Supreme secured in the standard fashion in a 19-kg boy undergoing repair of an inguinal hernia. Note that the distance between the upper lip and fixation tab should be approximately 1-2 cm.

## Table 1. RCTs of Various Supraglottic Airways

| Type of Device(s) Studied | Author | Study Population | Primary Outcome | Secondary Outcomes |
|---|---|---|---|---|
| air-Q vs Ambu Aura-i | Jagannathan N et al.[58] | 120 infants and children | No difference in time to tracheal intubation or intubation success | Leak pressures higher with air-Q in infants; pilot balloon could not pass through Aura-i size 1.5 |
| air-Q vs LMA Unique | Jagannathan N et al.[66] | Crossover in 50 children; sizes 1.5, 2 | Leak pressure higher with air-Q: 19 vs. 16 mm H20 (*P*=0.01) | Better fiber-optic view with air-Q |
| air-Q SP vs LMA Unique | Jagannathan N et al.[68] | 60 children; size 2 | No difference in leak pressure at start and at 10 min | No difference |
| i-gel vs Ambu Aura once | Theiler LG et al.[27] | 208 patients Sizes 1.5, 2, 2.5, 3 | I-gel higher 2235 cm $H_2O$ vs 1933 (*P*<0.01) | Time to insertion faster with Ambu<br>I-gel more prone for sliding out after insertion |
| LMA Classic vs i-gel | Lee JR et al.[33] | 99 patients Sizes 1.5, 2, 2.5 | No difference | i-gel: shorter insertion time and improved glottic view compared with the LMA Classic (*P*=0.001) |
| LMA Proseal vs i-gel | Fukuhara A et al.[34] | 134 patients 1.5, 2, 2.5, 3 | No difference | Fiberoptic view was significantly better with the i-gel than with the LMA Proseal (*P*=0.002), especially in larger children |
| LMA Proseal vs i-gel | Gasteiger et al.[29] | 51 patients Size 2 device | No difference: 22 vs 21 cm $H_2O$ | No differences |
| LMA Proseal vs i-gel | Mitra S et al.[31] | 60 patients; size 2.5 device | i-gel had higher airway leak pressures of the i-gel group 27 vs 22 cm $H_2O$ | No differences |
| LMA Proseal vs LMA Classic vs i-gel | Das B et al.[32] | 90 patients Size 2 device | i-gel higher leak pressure: 27 vs Proseal group 22 vs LMA Classic group 23 | No differences |
| LMA Proseal vs LMA Classic vs i-gel | Goyal R et al.[30] | 120 patients Size 2 | i-gel higher: 2632.6 vs 2331.2 (Proseal) vs 2232.3 (Classic) cm $H_2O$; (*P*<0.01) | No differences |
| LMA Supreme vs i-gel | Jagannathan N et al.[5] | 168 patients Sizes 1.5, 2, 2.5, 3 | Leak pressure: Higher with i-gel 20 cm $H_2O$ vs 17 cm $H_2O$ (*P*=0.001) | Airway manipulations needed to maintain a patent airway were greater with the i-gel |
| LMA Supreme vs LMA Proseal | Jagannathan N et al.[24] | 60 patients Size 2 device | Leak pressure: No difference: 19 vs 18 cm $H_2O$ | No differences in ease & success of insertion, fiber-optic views, and complications |
| LMA Supreme vs LMA Unique | Jagannathan N et al.[4] | 50 patients Size 2 device | Leak pressure: Higher with the Supreme: 20 vs 15 cm $H_2O$ (*P*=0.01) | LMA Unique faster to insert<br>Less rates gastric insufflation the with Supreme |
| LMA Supreme vs LMA Unique | Jagannathan N et al.[23] | 180 patients Sizes 1.5, 2, 2.5 | Leak pressure: No differences between devices in leak pressure at an intracuff pressure of 40 cm $H_2O$ vs 60 cm $H_2O$ | Less rates of gastric insufflation with the Supreme during PPV |

**LMA,** laryngeal mask airway; **PPV,** positive pressure ventilation; **RCT,** randomized controlled trial

The i-gel is available in sizes 1 (which lacks a gastric channel), 1.5, 2, 3, 4, and 5, with sizing based on patient's body weight. The proximal mask contains an epiglottic rest designed to prevent downfolding of the epiglottis into the ventilation orifice.

An observational study in 50 older children found easy insertion in all patients with a mean leak pressure of 25 cm $H_2O$; gastric access was successfully obtained (Table 2).[26] Another study compared the i-gel with the Ambu AuraOnce laryngeal mask and found higher airway leak pressures and longer insertion times with the i-gel.[27] The authors noted a tendency for the i-gel to slide out of the mouth and recommended taping to prevent intraoperative dislodgment. Other groups have observed spontaneous dislodgement after insertion,[5,28] perhaps the result of a relatively wider conical mask than other laryngeal masks with traditional designs.

Several randomized and observational studies have been performed on the pediatric i-gel. Investigators found leak pressures that are similar to[29] or higher

## Table 2. Observational Trials With Selected Supraglottic Airways

| Type of Device(s) Studied | Author | Study Population | Primary Findings | Secondary Findings |
|---|---|---|---|---|
| air-Q | Sinha R et al.[67] | 20 infants | Tracheal intubation successful in 19 of 20 patients | N/A |
| air-Q | Whyte S et al.[72] | 110 infants and children | Ventilation adequate in 108 of 110 cases; fiber-optic view of the vocal cords was obtained in 102 of 110 cases | N/A |
| air-Q SP all pediatric sizes | Jagannathan N et al.[69] | 352 children; 69 infants | 99% insertion success rate | No difference in complications among infants/older children |
| air-Q vs Portex Soft Seal | Komasawa N et al.[70] | 24 novice physicians on a neonatal manikin | Insertion time during chest compression was significantly shorter for air-Q than for Soft Seal ($P<0.05$) | N/A |
| i-gel: sizes 1.5, 2.0, 2.5 | Abukawa, Y et al.[73] | 70 children | Overall first-attempt success rate 94%. Gastric tube insertions easy in all patients. Overall leak pressure 23±5 cm $H_2O$ | Complications higher in size 1.5 group |
| i-gel: sizes 1.5, 2.0, 2.5 | Beringer RM et al.[3] | 120 children | Median insertion time 14 sec. Manual ventilation possible in all cases. Median (IQR [range]) leak pressure 20 (16-26 [8-30]) cm $H_2O$ | Fiber-optic inspection through i-gel revealed clear view of vocal cords in 40 of 46 cases (87%) |
| i-gel: sizes 1.5, 2.0, 2.5 | Hughes C et al.[28] | 154 children | First-insertion attempt successful in 93.5% of patients. Gastric tube placement successful in 90% of cases. Minor complications in 20% | Considerable vigilance required when fixing the device in the mouth and to avoid negative effects of flexion of the proximal tubing |
| i-gel: size 3 airway | Beylacq L et al.[26] | 50 children | All devices inserted at first attempt. Mean seal pressure was 25 cm $H_2O$ | There was no gastric inflation and gastric tube insertion was achieved in all cases |
| LMA Supreme: sizes 1, 2, 3 | Jagannathan N et al.[21] | 100 patients | First-time insertion success rate was 97%, with overall insertion success rate of 100%. | Gastric tube placement possible in 98% of patients |
| LMA Supreme vs LMA Proseal and LMA Classic | Trevisanuto D et al.[25] | 40 clinicians Neonatal manikin | Maximal inflation pressure and quality perceived by the operator are higher with Supreme than with LMA Classic and LMA Proseal | Time to effective ventilation with Supreme is superior to Proseal |

**SP,** self-pressurized

## Case 2.

**A 2-week-old ex full-term male with Pierre Robin Sequence and severe micrognathia presented for mandibular distraction osteogenesis. He was kept prone in the neonatal ICU because he had severe obstruction of the upper airway in the supine position.**

**The patient arrived to the operating room in the prone position with a dextrose infusion running. After applying standard monitors, an air-Q laryngeal mask was inserted awake in the prone position with the patient's head turned laterally. After confirmation of adequate air exchange, anesthesia induction was performed with sevoflurane in oxygen. The patient was then turned supine and deep inhaled anesthesia was confirmed by lack of response to a 5-second jaw thrust. Nasal fiber-optic intubation was performed after removal of the laryngeal mask.**

**In this case, the laryngeal mask served as bridge to oxygenate and ventilate from induction of general anesthesia until tracheal intubation.**

than[30-32] to those with the LMA Proseal and higher leak pressures than both the LMA Supreme[5] and LMA Classic.[30,31] One study found no difference in airway leak pressure between the LMA Classic and i-gel,[33] but suggested that the i-gel was faster to insert. Better fiber-optic views with the i-gel were demonstrated compared with the LMA Classic[33] and LMA Proseal,[34] whereas other authors reported no such differences.[29] Although fiber-optic views through the i-gel appear desirable, no formal study has been performed using the i-gel as a conduit for tracheal intubation in children.

### Tracheal Intubation Through SGAs

Laryngeal masks are ideal conduits for tracheal intubation in children who fail direct laryngoscopy. This approach is supported by several published algorithms.[35,36] Advantages include continuous oxygenation during intubation, hands-free operation, and relief of upper airway obstruction.[37,38]

The most common conduit for tracheal intubation in children remains the LMA Classic, although it was not designed for this purpose. The LMA may be used as a conduit for tracheal intubation in children with a few limitations. These limitations are addressed by 2 new laryngeal masks designed to facilitate tracheal intubation in children: the air-Q Intubating Laryngeal Airway (ILA, Mercury Medical) and the Ambu Aura-i.

#### *LMA*

Several methods for placing a TT using an LMA have been described: blind, fiber-optic–guided, stylet or bougie-assisted, and retrograde-guided.[39-42] A fiber-optic-guided technique for placement of a TT may be the best method for intubating through an SGA because of the variable incidence of epiglottic downfolding.

One unique challenge in children is that the lengths of the LMA and conventional TTs may be similar, making it difficult to maintain tracheal intubation while removing the LMA. Removing the LMA over the TT may cause simultaneous withdrawal of the tube.[43-45] Proposed solutions include leaving the LMA in place[45,46] cutting and shortening the LMA,[47] and using longer TTs.[48] Each of these techniques has disadvantages and requires extra steps that can be impractical when managing the difficult airway. Leaving the LMA in place makes securing the ETT difficult. Modifying the LMA may affect its function, resulting in the inability to provide oxygen.

When a fiber-optic bronchoscope (FOB) is used to place the TT, the LMA may be withdrawn over the scope. The TT is then grasped, passed through the LMA outside of the patient's pharynx, and threaded over the FOB into the trachea.[41,49,50] An alternative is to telescope 2 identical TTs end-to-end, or to use 2 TTs whose internal diameters differ by 0.5 mm.[51,52] These TTs are then threaded onto the FOB. The proximal tube is used to maintain the lower tube in position until the LMA is withdrawn.[53,54] The proximal TT is then removed, the 15-mm adapter is replaced on the lower tube, and the correct position confirmed. The TT also can be stabilized by using laryngeal forceps while removing the LMA.[55,56] Continuous ventilation during the intubation may be achieved by using a swivel adapter attached to the LMA or TT.[43,46,57]

#### *AIR-Q*

The air-Q (Mercury Medical) is an oval-shaped laryngeal mask with a shortened, wide, hypercurved airway tube designed as a conduit for tracheal intubation. It also can be used for routine anesthetic maintenance. Manufactured as both reusable and single-use devices, the air-Q has 3 versions: cuffed; self-pressurized (air-q SP, which lacks an inflatable cuff); and the air-Q with an esophageal blocker, which allows for evacuation of gastric contents but is not yet available for children.

The air-Q is available in sizes 0.5, 1.0, 1.5, 2.0, 2.5, 3.5, and 4.5, based on patient weight. It offers some advantages over traditional laryngeal masks when used as a conduit for tracheal intubation in children. The air-Q has a wider airway tube that accommodates cuffed TTs; it is shorter, facilitating removal of the mask after tracheal intubation; and it has a removal stylet for stabilizing the tracheal tube when removing the SGA.

The mask contains an elevated keyhole-shaped ventilating orifice that helps prevent epiglottic downfolding, although this complication still occurs in smaller children.[15,58] The air-Q performs well as a conduit for tracheal intubation and has been successfully used in children with difficult airways.[38,59-65] A red tag attached to the pilot balloon equalizes the pressure in the mask to atmospheric pressure, and the device should be inserted with the tag attached. The mask is advanced along the tongue base until slight resistance is encountered; a jaw thrust is then performed with the nondominant hand, and the mask inserted further until resistance is felt. Before intubation, the 15-mm adapter of the air-Q must be removed.

A unique advantage of the air-Q is the ability to expeditiously remove the device after successful tracheal

intubation with smooth passage of the pilot balloon without modification of the TT.[15,58]

Multiple comparative studies have evaluated the air-Q against various other SGAs (Table 1). The air-Q was compared with the LMA Unique in 50 children aged 6 to 36 months.[66] The air-Q had higher airway leak pressures and superior fiber-optic grade of view than the LMA. Three other studies evaluated the air-Q as a conduit for tracheal intubation in infants and children; tracheal intubation was successful in 19 of 20 infants[67] and 100 of 100 children,[15] and 60 of 60 infants and children.[58]

For routine anesthetic maintenance, the self-pressurized air-Q performed similarly to the LMA Unique in a randomized trial.[68] It also performed well in a large observational study of infants weighing less than 10 kg.[69] A study of 120 infants and children compared the air-Q with the Ambu Aura-i for fiber-optic–guided tracheal intubation. Both devices were effective conduits for fiber-optic–guided tracheal intubation with similar median tracheal intubation times.[58] However, the size 1.5 Aura-i, because of its narrower proximal airway tube, will not allow the passage of cuffed TTs. In a neonatal resuscitation study, novice doctors found the air-Q easier to use than the Soft Seal (Portex) laryngeal mask for emergency airway management during chest compression on an infant manikin.[70] The air-Q is currently the most ideal SGA for tracheal intubation in children.

### *Ambu AuraOnce and Ambu Aura-i*

The Ambu AuraOnce and Ambu Aura-i are available in pediatric sizes. Their mask bowls are similar in design to that of LMA Clasic. The mask has no design features to prevent epiglottic dowfolding. The Ambu AuraOnce performed well when compared with the i-gel. Although it was faster to insert, the i-gel was associated with higher airway leak pressures.[27] Another randomized study evaluated several laryngeal masks as conduits for diagnostic and therapeutic bronchoscopy and found that masks made of polyvinyl chloride, including the AuraOnce, were associated with greater resistance to bronchoscope manipulation during flexible bronchoscopy procedures than were silicone devices.[71] The aura-I is designed for tracheal intubation in children and was found in one study to be comparable to the air-Q for these purposes.[58]

## Conclusion

As SGAs continue to evolve, newer designs may enhance patient safety by providing a means of confirming adequate position of the mask and allowing for evacuation of gastric contents. Although the stability of laryngeal masks in small children remains a concern, recent studies with newer laryngeal masks have demonstrated the utility of these devices in this patient population. Future designs should incorporate features to allow continual assessment of mask position to help optimize clinical performance. Moreover, multicenter trials may help in better defining which SGAs may be best suited for use in small children. Laryngeal masks are invaluable in the care of children with normal and abnormal airway anatomy. It is imperative that all practitioners who care for children be familiar with their strengths and limitations. Safety and efficacy of these devices can then be better defined with frequent routine use these devices in pediatric clinical practice.

## Case 3.

**A 3-year-old (15 kg) boy with Goldenhar syndrome presented for tonsillectomy and adenoidectomy. A size 2 air-Q laryngeal mask was prepared before induction of anesthesia. A cuffed TT was partially inserted into the airway tube of the SGA and the cuff inflated. A bronchoscopic swivel adaptor was attached to the end of the tracheal tube (Figure 2). This unit was inserted in the anesthetized patient. The anesthesia circuit was connected to the swivel adaptor and PPV confirmed.**

**Fiber-optic bronchoscopy was performed through the swivel adaptor while ventilation was maintained. Topical lidocaine was applied to the vocal cords and trachea, and fiber-optic intubation was carried out through the air-Q. The air-Q was removed after intubation using a disposable removal stylet supplied with the mask.**

**In this case, the air-Q facilitated continuous ventilation throughout the intubation of a patient who would have become hypoxic if an apneic technique had been used.**

**Figure 2.** A continuous ventilation technique: a bronchoscopic swivel adaptor attached to the end of the tracheal tube (also attached to the anesthesia circuit) which is inserted into a size 1 air-Q.

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