

Small is the new big: An overview of newer supraglottic airways for children

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Abstract

Almost all supraglottic airways (SGAs) are now available in pediatric sizes. The availability of these smaller sizes, especially in the last five years has brought a marked change in the whole approach to airway management in children. SGAs are now used for laparoscopic surgeries, head and neck surgeries, remote anesthesia; and for ventilation during resuscitation. A large number of reports have described the use of SGAs in difficult airway situations, either as a primary or a rescue airway. Despite this expanded usage, there remains little evidence to support its usage in prolonged surgeries and in the intensive care unit. This article presents an overview of the current options available, suitability of one over the other and reviews the published data relating to each device. In this review, the author also addresses some of the general concerns regarding the use of SGAs and explores newer roles of their use in children.

Key words: Air Q, Ambu Aura, i-gel, laryngeal mask airway, laryngeal tube suction, pediatric, pediatric airway management, 2nd generation device, supraglottic airways

Introduction

Since the last review in 2009 by White *et al.* and Ramesh and Jayanthi in 2011,^[1,2] many advanced supraglottic airway (SGA) devices are now available in smaller sizes thereby expanding their usability and reliability for pediatric airway control. It is not that the older devices did not perform well, but the newer ones come with added features that have increased the options for their use for specific indications. This review addresses some of the general concerns about SGAs in children and briefly describes the newer devices and their role in specific clinical scenarios.

Evolution of Supraglottic Airways

Everything is difficult before it becomes easy

The SGA saga began in East End of London in 1981 when Dr. Archie Brain felt the need for an effective airway that could

be inserted easily, rapidly, without any trauma when used even by the unskilled. After several years of material and design modification, the laryngeal mask airway (LMA) was created and marketed in late 1987. The first reports on the pediatric classic LMA (cLMA) came in the early nineties. The flexible and ProSeal LMA came later, along with additional features. Meanwhile, from 2003 onwards when the patent for cLMA expired, other manufacturers (Portex Soft seal, Cobra PLA, Ambu Aura) started marketing similar pediatric devices with some design modifications, both in reusable and disposable forms. Most of the other advanced models were launched after 2009 such as LMA Supreme and i-gel, with a gastric drain port; and Air Q and Ambu Aura i, the first intubating airway devices in pediatric sizes. Table 1 shows some of the characteristics of the SGAs available in pediatric sizes. The core issues of the supraglottic approach to the airway that the newer designs have targeted to address are gastric insufflation, airway protection, effective ventilation and securing definitive airway in difficult scenarios.

The Anatomy

The airway is funnel shaped in children, widest at the supraglottic level and narrowest at the subglottic compared to the uniformly cylindrical larynx in adults.^[3] The supraglottic area appears to be proportionately as wide as in adults and, therefore, the pediatric SGAs function well as a scaled down version of the adult. However, the evidence in adults should

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Table 1: Pediatric supraglottic airways-characteristics and special features

Supra glottic device	Year since pediatric sizes available	Size	Reusable (R) disposable (D) both (R/D)	1 st or 2 nd generation device	Unique features in the design
Classic LMA	Early 1990s	1-2.5	R	1 st generation	Epiglottic bars
LMA unique	A decade later		D		No epiglottic bars
Flexi LMA	Late 1990s Recent	>2 1-1.5	R/D	1 st generation	Long, narrow, flexible shaft
Soft seal	2003	1-2.5	D	1 st generation	Unique cuff
Vital seal	2003	1-2.5	D	1 st generation	Cuff with reinforced tip
Cobra PLA	2003	1-2.5	D	1 st generation	Tip like cobra head, elliptical cuff
ProSeal LMA	2005	1-2.5	R	2 nd generation	Gastric drain tube, shorter reinforced shaft, deeper cuff bowl, bite block, no dorsal cuff, patented introducer
Laryngeal tube	2005	0-2.5	R	1 st generation	Two cuffs with a common inflation line
LTS	2007	1-2.5	R	2 nd generation	Gastric drain tube
Ambu Aura		1-2.5		1 st generation	Cuff with reinforced tip
Once	2004	1-2.5	D	1 st generation	Preformed curved shaft
Aura 40	2005	1-2.5	R	1 st generation	Preformed curved shaft
Straight	2007	1-2.5	D	1 st generation	Straight shaft
Aura flex	2007	1-2.5	D	1 st generation	Flexible shaft
Aura i	2010	1-2.5	D	1 st generation	Intubating device with broad, short and curved shaft
Supreme LMA	2009	1-2.5	D	2 nd generation	Preformed shaft, bite block, gastric drain tube
i-gel	2009	1-2.5	D	2 nd generation	Made of thermoplastic elastomer, non-inflatable cuff, gastric drain tube (except in size 1)
Air Q	2009 2012	1-1.5 0.5	R/D	1 st generation	Intubating device with broad, short shaft
Air Q SP	2011	1-2.5	R/D	1 st generation	No pilot balloon, self-pressurized
Air Q blocker	Recent	≥2.5	D	2 nd generation	Gastric drain tube with cuffed blocker
AES ultra CPV	Recent	1-2.5	D	1 st generation	Color-coded cuff pressure indicator in pilot valve, MRI compatible

LMA = Laryngeal mask airway, LTS = Laryngeal tube suction, PLA = Perilaryngeal airway, CPV = Cuff pilot valve, MRI = Magnetic resonance imaging

not be extrapolated to infants and smaller children because of the difference in their respiratory physiology (low functional residual capacity and, therefore, low tolerance to hypoxia). Besides, the epiglottis is large and floppy in smaller children and can partially obstruct the glottic view due to its down folding during insertion of the device. Various techniques have been described in the literature to overcome this obstruction such as insertion with inflated or partially inflated cuff, insertion with 90° or 180° rotation, to name a few. Some of the devices have a specially designed reinforced cuff tip to prevent epiglottic down folding (Vital seal, Anandic Medical System, Feuerthalen, Switzerland and Ambu Aura, Ballerup, Denmark).

General Considerations

Reusable versus disposable supraglottic airway

Most SGAs are available in reusable (40-50 times use) as well as disposable forms. Reusable SGAs have been commonly used across the globe in the past because of their easy availability and possibly, reduced cost per patient but they have also been implicated as likely vectors for transmission of prion disease, e.g., Creutzfeldt-Jakob disease. Prions are infective proteins that are present in higher concentration in

the tonsillar tissue and are likely to adhere to a SGA during use (more with local mucosal trauma). Studies have shown that these proteins are resistant to conventional cleaning and autoclaving.^[4,5] Coetzee reported that though no method completely eliminates protein contamination, ultrasonic cleaning was more effective than manual cleaning.^[6] Richards *et al.* recommended that all devices be cleaned in isolation because protein cross-contamination occurs mainly during batch cleaning.^[7] Though the author could not find any case of prion disease transmission with the use of SGA in literature (cases reported with neurosurgery and corneal surgery, not related to SGA),^[8] some guidelines suggest that only disposable devices be used for tonsillectomies where the transmission risk is very high.^[9] The author recommends the use of disposable devices for all suspected or diagnosed cases of prion disease and suggests that they be preferred over reusable devices for other routine cases also.

Cuff Pressure

When the supraglottic cuff pressure is more than the mucosal perfusion pressure, it is likely to either cause postoperative pharyngolaryngeal symptoms like sore throat (dysphagia, dysphonia) or cause local mucosal trauma and nerve injuries.^[10]

SGAs with inflatable cuffs are prone for over inflation and may create pressures higher than 60 cm H₂O, with maximum recommended volume of inflation typically with nitrous oxide that readily diffuses into the cuff.^[11] Some of the newer devices like Air Q have recommended lower inflation volumes.

In 2010, Hockings *et al.* studied LMA size 1.5-3 with three different cuff pressures (20, cm 40 cm and 60 cm H₂O) and found the lowest leak volume at a cuff pressure of 40 cm H₂O and the highest at 60 cm H₂O in all sizes.^[12] Other studies (Ong *et al.*, Licina *et al.*) have also demonstrated that clinical endpoints do not correctly estimate cuff pressures and higher pressures do not provide either better seal or lower leak, and on the contrary are liable to cause more morbidity.^[13,14] It, therefore, seems prudent to routinely monitor cuff pressure with a manometer. If it is not feasible in routine clinical practice, the author recommends the SGAs be inserted with the packaged volume of air in the cuff (that may be enough in many cases)^[15] or cuffs to be inflated with the minimal volume of air that creates the best seal and provides adequate ventilation; caution must be exercised during their prolonged use.

Oro-pharyngeal Seal Pressure

The crux of ventilation (especially positive pressure ventilation) is an effective seal of the glottis. A good seal facilitates good ventilation, as well as maintenance of the desired depth of anesthesia at lower fresh gas flows (without polluting the environment with the leaked gases). Lesser leaks into the esophagus prevent rise of intragastric pressure and thereby reduce the risk of regurgitation. However, the arithmetic of a good seal that assures complete airway protection has not been worked out. Theoretically, it may be agreed upon that it should be more than the ventilating airway pressure, but there is limited evidence to support a complete protection of the airway from blood and secretions (more so in oral/nasal surgeries). The author also recommends the oropharyngeal seal pressure (OSP) to be assessed routinely and also rechecked with every change of patient position. At this juncture, it is further clarified that a SGA is indicated only for fasting patients, thereby not meant to completely protect the airway from the gastric contents in spite of a good glottic seal.

Fiberoptic View Through a Supraglottic Device

Most studies have attempted to correlate the fiberoptic bronchoscope (FOB) view through the SGA with ease of ventilation and intubation. A clear view of the glottis using the FOB has been correlated with adequate ventilation

and easy endotracheal intubation via the SGA conduit. However, the FOB scoring has now been challenged as a dependable tool for SGA positioning.^[16] Loke *et al.* found epiglottic impingement in 60% cases in size 2 cLMA, 58% in size 2.5 ($n = 67$) but all the children could be adequately ventilated.^[17] Von Ungern-Sternberg *et al.* also demonstrated good ventilation despite poor FOB view (55% in smaller and 75% in larger cLMA).^[18] It thus appears that a full glottic view may be neither achieved nor always necessary for primary ventilation. However, the blind passage of an endotracheal tube (ETT) is not recommended in view of possible trauma.

Overall, it would be prudent to appreciate the subtle interplay between glottic seal (or leaks around the cuff), cuff pressure (or inflation volume) and anatomic positioning of the device (or FOB view). Therefore, an optimal seal and cuff pressure should be maintained for all cases and a good FOB view would be preferred for the intubating devices.

The Cost Factor

The factors that affect the overall cost are the cost of the SGA (disposable or reusable, 1st or 2nd generation type) and the infrastructure, time and staff required to re-sterilize the reusable devices. However, there is currently no data available on the use of SGA based on cost issues.

Overview of Supraglottic Airways Currently Available in Pediatric Sizes

The cLMA has been the benchmark SGA for many years but since 2003, after the expiry of its patent, there have been many other 1st generation devices available in small sizes, some with additional features for better performance.^[19,20] Vital seal and Ambu Aura have reinforced cuff-tip; the cuff of Portex® Soft Seal® (Smiths Medical, Kent, UK) has lesser permeability to nitrous oxide; and Ambu AuraOnce has a preformed shaft in order to facilitate easy insertion.

Flexible LMA, the first modification of the cLMA was specially designed for head and neck surgeries with a longer and narrower reinforced airway tube that could be folded and taped on the chin. It is now marketed as a reusable device, LMA Flexible™ (disposable version also available) and as single use in all sizes as Ambu AuraFlex, Laryseal Flex and AES Ultra Flex cuff pilot valve (CPV).

Cobra perilaryngeal airway (CobraPLA, Engineered Medical System, Indianapolis, IN, USA; 2003) is a single use 1st generation device with similar ventilator efficacy vis-a-vis cLMA (Szmuk $n = 200$; Gaitini $n = 80$ higher OSP)

though some studies have raised a few concerns regarding its safety (Polaner: Epiglottic folding in 77% infants; Passariello: Gastric insufflation in 21% children; Sunder: Device instability requiring frequent head adjustments in eye surgery).^[21-25] With better and more reliable SGAs available for children, the CobraPLA is not particularly recommended for routine use.

ProSeal LMA (reusable with gastric drain port, bite block and a patented introducer as shown in Figure 1) has been used for spontaneous/controlled ventilation, laparoscopies, neonatal and pediatric resuscitation and as a conduit for tracheal intubation in children since 2005.^[26,27] It was the first 2nd generation SGA with a drain port that allows passage of a drain tube through the esophagus up to the stomach for emptying fluids/gases so that the intra-gastric volume and pressure are low and the incidence of regurgitation is reduced. The ProSeal LMA has been the most reliable and thus most preferred SGA in children.^[1]

Laryngeal mask airway Supreme is similar to ProSeal LMA except that it is single use and has a preformed shaft that obviates the need for an introducer [Figure 2]. Various studies have shown good airway characteristics with LMA Supreme in children.^[28-32] Jagannathan *et al.* found it comparable with the ProSeal LMA and Francksen *et al.* with the i-gel and recommended it as an useful alternative to ProSeal LMA.^[33,34] However, besides personal preference, disposability and cost, there is no other obvious advantage of Supreme over the other 2nd generation SGAs in children.

Laryngeal tube (LT, VBM, Medizintechnik, GmbH, Germany; size 0-2.5) and its advanced version LT suction (LTS II; size 1-2.5) are SGAs with two cuffs (oropharyngeal and esophageal) with ventilation holes in between and an additional suction port in LTS II [Figure 3]. Though initial reports by Richebé *et al.* suggested reliable ventilation with LT only in children >10 kg, Schalk *et al.* found LT II a good alternative airway for children ($n = 12$, age 2-6 year) in difficult scenarios when endotracheal intubation and other SGAs had failed.^[35,36] Gaitini *et al.* compared LTS II with the ProSeal LMA and found it equally effective with higher OSP during spontaneous ventilation in children.^[37] Though currently there is limited research on the efficacy and safety of LT for routine elective use in children, it promises to be a good tool in the difficult or emergency airway cart.

Air Q Masked Laryngeal Airway

For many years, there were no intubating laryngeal masks available for children <30 kg. In 2009, Air Q (Cookgas LLC, Mercury Medical, Clearwater, Florida, USA)

launched the first intubating masked laryngeal airway in size 1 and 1.5 (also size 0.5 for <4 kg weight neonate, later in 2012) for small children [Figures 4a and b]. The shaft is broader, shorter and slightly curved with an elliptical cross-section (room for pilot balloon of ETT) and the color-coded

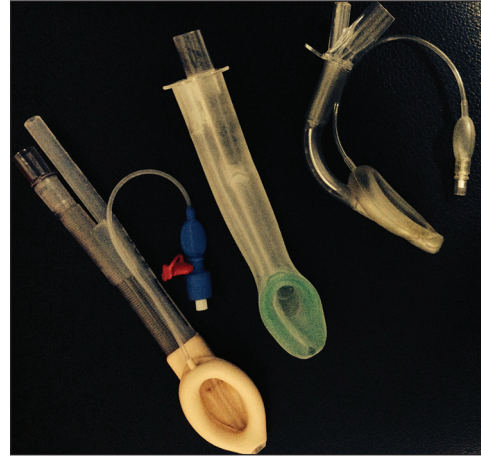


Figure 1: Second-generation supraglottic devices (ProSeal laryngeal mask airway [LMA], i-gel, LMA Supreme)



Figure 2: Laryngeal mask airway Supreme

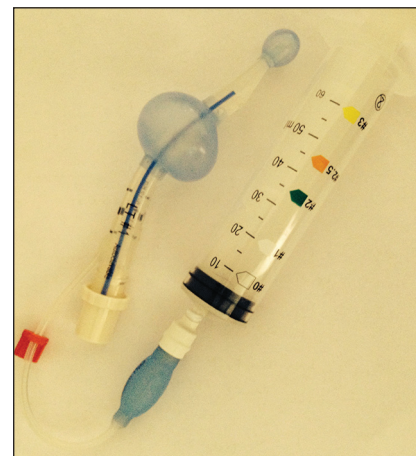


Figure 3: Laryngeal tube suction with color coded syringe to fill the cuffs

15 mm connector can be removed (but tethered to the shaft to avoid misplacement) for placement of a larger ETT. The elevation ramp and the keyhole shaped airway outlet help to direct the ETT toward the laryngeal inlet. The recommended volume of inflation and intracuff pressure (<60 cm H₂O, ideal 20-30 cm H₂O) are lesser than other devices of the same sizes. Endotracheal intubation via Air Q can be FOB guided or with an optical stylet. A patented tapered adapter that has ridges and grooves for firm fitting into the ETT can be used for removal of the device after intubation. In a recently published study, Whyte *et al.* studied 110 children of different ages using Air Q size 1-2.5 as a primary airway in five different head positions and found adequate ventilation in 108/110, good FOB view in 102/110, and an increase in OSP in flexion and decrease in head extension position.^[38] There was blood staining on removal in 5%. Jagannathan *et al.* showed 100% success of tracheal intubation via Air Q (FOB, optical stylet, blind technique) during a retrospective audit over 1-year in 34 children with difficult airway.^[39]

There is no pilot balloon for mask inflation in Air Q self-pressurizing (SP) masked laryngeal airway [Figure 4c]. An aperture between the airway tube and the cuff creates an open space with the incoming airflow that allows cuff inflation and pressure regulation, thereby avoiding the overinflation issues. Jagannathan *et al.* compared Air Q SP with LMA Unique (single use cLMA) in 60 children using size 2-2.5 and found good airway quality in both groups.^[40] There was dysphonia (1/30) and dysphagia (4/30) in five cases of LMA Unique only (with cuff pressure 58-73 cm H₂O). The authors have suggested Air Q SP as an effective alternative device where routine cuff pressure monitoring is not done.

Air Q blocker is the latest version but presently available only till size 2.5 for children weighing >30 kg. It has a drain tube through which a suction tube is passed. There is an inflatable cuff at the end of this tube. On inflation, the cuff seals the esophageal opening into the stomach, preventing any regurgitation of stomach contents.

Ambu Aura

The Ambu Aura (Ambu A/S, Ballerup, Denmark) family of SGA has a variety of types like AuraOnce (single use, preformed shaft as shown in Figure 5), Aura 40 (preformed shaft, reusable), AuraStraight (straight shaft), AuraFlex (flexible shaft) and Aura i (intubating device as shown in Figure 6). There is no suction port in any model, and all are single use devices except Ambu 40. Ambu also manufactures a cuff pressure gauge, which has two “green” zones that indicate separate safe cuff pressure range for SGA and ETT.

Overall, these devices have been shown to perform as well as their equivalents by other manufacturers without any obvious advantage over them.

Theiler *et al.* compared Ambu AuraOnce with i-gel in 208 children aged 1-17 years and found good overall performance with high OSP and success rate for both the devices.^[41] When Jagannathan *et al.* compared the two intubating SGAs, Ambu Aura i and Air Q he found them to be equally effective in children except that size 1.5 of Aura i had limited space for a cuffed ETT.^[42]

i-gel, a single use 2nd generation SGA with a non-inflatable cuff has been available in small sizes since 2010 [Figure 1]. The epiglottic rest and side rims prevent downfolding of epiglottis, and the gastric port allows a 10-12 Fr suction catheter (absent in size 1). Easy insertion and high OSP has been reported with pediatric i-gel (Goyal 26; Fukuhara 22; Mitra 27 cm H₂O), and there are no issues of overinflation because of the non-inflatable cuff.^[43-45] Insertion of i-gel in the prone position as a rescue airway has also been reported in children. Overall, the author recommends i-gel as an effective

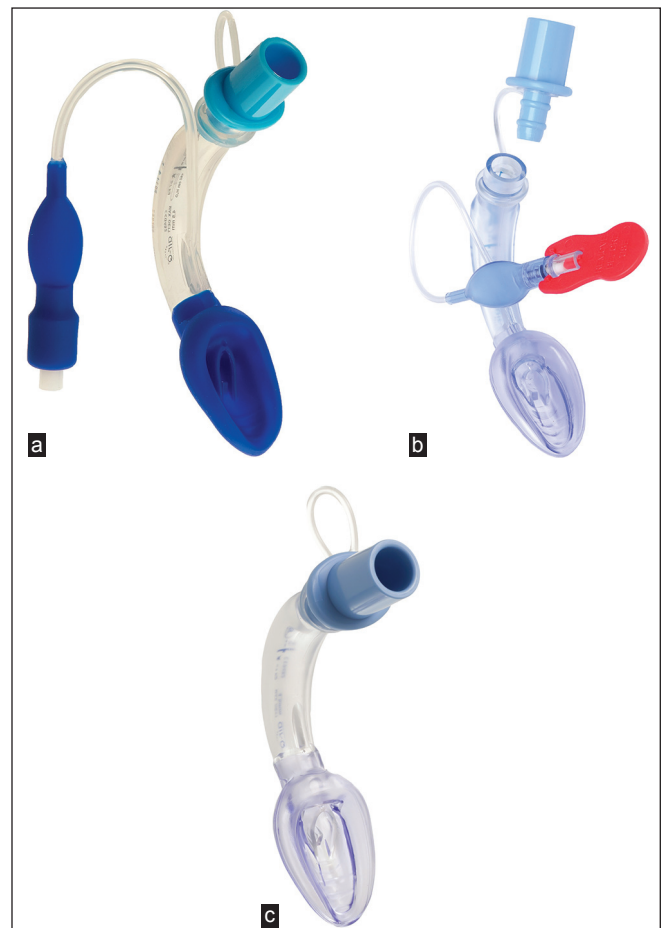


Figure 4: Air Q intubating reusable (a) and disposable (b); Air Q self-pressurized (c) with permission from Mercury Medical, Clearwater, Florida for using the images



Figure 5: Ambu AuraOnce



Figure 6: Ambu Aura i

2nd generation device for children but suggests that it must be secured with a tape after insertion to prevent displacement.

Streamlined Liner of the Pharyngeal Airway (Hudson, RCI) has a boot-shaped plastic body and a non-inflatable cuff, but there is no remarkable evidence in the last decade that supports its routine use in children.

The recently launched AES Ultra CPV (AES Inc., Black Diamond, WA, USA) promises to change the art of manually assessing the cuff pressure to a science of objective endpoint by incorporating a pressure indicator in the pilot balloon. It has three color zones that guide the user to inflate/deflate the cuff in order to maintain optimal pressure limits. It is single use (silicone/PVC/reinforced silicone), magnetic resonance imaging (MRI) compatible and manufactured in all sizes. Currently, there is no published study for AES ultra in children.

Specific Scenarios

Laparoscopic surgeries pose unique challenges due to concerns of pneumoperitoneum, Trendelenburg position and low

functional residual capacity in children. Ozdamar *et al.* used cLMA ($n = 40$) after inserting a nasogastric tube postinduction and did not have any case with pulmonary aspiration.^[46,47] Sinha *et al.* used ProSeal LMA in 30 children 6-month-8 year and found a comparable ventilation efficacy (OSP 29 cm H₂O) with ETT ($n = 30$) without any major complication.^[48] Mironov *et al.* also used LMA for 127 children undergoing short laparoscopic surgery and found stable hemodynamics, adequate ventilation and shorter awakening time compared to ETT.^[49]

Though the present evidence of the safe use of SGA for laparoscopic surgeries is still limited, the 2nd generation devices (ProSeal LMA, LMA Supreme and i-gel) should be (at least theoretically) better suited to provide adequate ventilation with greater safety (against gastric insufflation and regurgitation).

Gastrointestinal Endoscopy

Upper gastrointestinal endoscopy requires deep sedation in children and an SGA can be used for assisting ventilation (without using a neuromuscular blocking agent). Fuentes-García *et al.* used cLMA and found similar efficacy with ETT except one failure.^[50] Lopez-Gil *et al.* found ProSeal LMA insertion quicker with fewer airway complications compared with nasal prongs.^[51] The pediatric endoscope can also be inserted through the drain port of a 2nd generation SGA making it possible to ventilate and operate at the same time. The gastro-LT is a modification of the LT with a dedicated channel for endoscope, but there is no literature on its availability or use in children.

Fiberoptic Bronchoscopy

Supraglottic airway can be used to administer oxygenation as well as provide a conduit for FOB in children.^[52] Baker *et al.* used cLMA, Ambu AuraOnce, Portex Soft Seal, Boss Systems disposable silicone laryngeal mask and LMA Unique for flexible bronchoscopy in 100 children and felt lesser resistance with silicone (cLMA and Boss Systems) compared to PVC cuff during endoscope manipulation.^[53]

Remote Locations

When LMA is used during MRI, the ferrous content in the pilot valve interferes with the MRI findings, and this may sometimes lead to a misdiagnosis.^[54] An *in-vitro* study of six SGAs (Classic, Unique, ProSeal, Supreme, Ambu AuraOnce, i-gel) showed artifacts in all except two devices Ambu and i-gel (no ferrous content) suggesting their suitability for MRI.^[55,56] The other available MRI compatible

devices are AES Ultra, Solus™ LMA (Intersurgical, Berkshire, UK) and Laryseal™ MRI (Flexicare Medical Ltd., MG, UK).

Supraglottic airways have been effectively used for children undergoing other radiological and radiotherapy.^[57,58]

Adenotonsillectomy

Although ETT is the gold standard, there is now good evidence that LMA can be used effectively and safely for adenotonsillectomies.^[59,60] Airway soiling with blood and obstruction due to mouth gag, leading to conversion to ETT were some of the concerns raised against the LMA, but most studies have proved this otherwise. John *et al.* used methylene blue dye in 64 patients to demonstrate LMA as an effective barrier to airway soiling.^[61] Other investigators also found lesser incidence of aspiration with LMA as compared to ETT.^[62] Besides, active upper respiratory tract infections are common in these children, and studies have shown that the incidence of respiratory complications is significantly lesser with LMA.^[63,64] Overall, it is important that both the surgeon and the anesthesiologist are familiar with its use, and the device is leak tested > 15 cm H₂O before surgery.^[65] The different devices with flexible airway tubes (mentioned earlier in the article) should be preferred for all head and neck procedures.

Prone Position

Several case reports have described the successful use of SGA in the prone position in children. Dingeman *et al.* used an LMA (5-year-old, Arnold Chiari malformation for decompressive craniectomy; 2005) and Taxak and Gopinath (2.65 kg neonate for meningomyelocele surgery; 2011) used an i-gel as a rescue device following sudden accidental extubation in prone position.^[66,67] However, the author feels that their elective use in the prone position may be just an act of worthless heroism.

Difficult Airway

Pediatric SGAs have redefined difficult airway, urging us to consider “Can intubate, Can ventilate” in place of “Can’t intubate, Can’t ventilate” in several circumstances. Though Air Q and Ambu Aura i are designed and used as a conduit for endotracheal intubation^[68-72] there are many case reports of successful use of other SGAs (cLMA, i-gel) as primary or rescue airway in difficult airway situations.^[73-82] Walker used LMA in 34 children with Cormack-Lehane grade 3-4 without a single failure.^[83] They could get the full view of the glottis (Grade

I FOB view) in 73% and partial view (Grade II) in the rest 27% of the cases. In a recent retrospective analysis of difficult airways over a 4-year period, Jagannathan *et al.* showed successful use of an SGA in 96% cases where it was electively used for primary management (109 out of a total of 459 cases with Cormack-Lehane grade 3-4).^[84] However, in an accompanying editorial Asai clarified that it did not mean that SGA can be used for all difficult airways (not for children at risk for pulmonary aspiration, with collapsible airway disease, ventilation required at high pressure, restricted mouth opening).^[85]

In a recent survey on the practice of pediatric SGA in the UK, 99% of the respondents considered SGA as an important airway tool in difficult airway management.^[86] The majority (79%) preferred the classically shaped laryngeal masks in failed intubation scenarios.

Neonatal and Pediatric Resuscitation

2010 International Consensus on cardiopulmonary resuscitation mentions the role of LMA (Classic) as an alternative to mask/ETT or as a primary airway in neonate >2 kg weight and >34 weeks gestation.^[87-89] ProSeal LMA has also been reported for use in neonatal resuscitation.^[90,91]

During pediatric resuscitation, LMA has been recommended in case of unsuccessful bag-mask ventilation or when endotracheal intubation is not possible.^[92] Considering the airway characteristics, the newer SGAs are also expected to function similar to their older counterparts for resuscitation in infants and children.

Problems and Failure

By far, it is well agreed that ventilation can be adequately provided with a SGA to a child, but the biggest fear is the risk of pulmonary aspiration. Though SGAs are used in adequately fasted patients and may be avoided in those with known high risk of aspiration, there may be other factors that can increase the risk of regurgitation such as inadequate depth of anesthesia, gastric insufflation during positive pressure ventilation due to oropharyngeal leaks and pneumoperitoneum. Nonetheless, mild regurgitation is not commonly known to result in clinically significant pulmonary aspiration. With the more frequent use of 2nd generation SGAs and routine aspiration of the stomach contents after its insertion, these incidents are now rarely reported in children.

Lingual edema with large LMA in an infant after prolonged use and retention of plastic cuff shield in the oropharynx of a 5-year-old child, 1-day after removal of size 2 Ambu

AuraStraight are some of the SGA-related adverse incidents reported in the literature.^[93,94] Currently, there is no evidence supporting the use of SGA for prolonged duration in children, and more studies would be needed for further insight.

Recently, Mathis *et al.*, the guardian of the “big data of pediatric anesthesia” reported an incidence of 0.86% for LMA (Classic/Unique) failure in 11,910 planned pediatric cases vis-a-vis 1.1% in adults as shown by Ramachandran *et al.* in 2012.^[95-97] They revealed obstruction (48%) as the leading cause and also brought out some of the clinical correlations associated with these failures (ENT surgeries, non-outpatient admission status, prolonged surgical duration, airway abnormality and patient transport). Although this data monolith reveals a favorably low incidence of LMA failure, it is not “one ring to rule them all” but “small pieces loosely joined” that matter. In this case, a large number of controlled trials that aim to study the power of the individual factor associations need to be analyzed.

As far as the newer SGAs are concerned, the studies are adequately powered for efficacy but there is currently limited safety data for these devices. Further research on animal and cadaveric models, as well as simulator-based studies may bring in more insight into the safety aspects of the SGAs.

Conclusion

It is not that the “old order changeth” but it is the multifarious disposition of the new that has opened more doors for the pediatric airway. Notwithstanding the availability and cost factors, the newly introduced devices offer greater usability. The evolving SGAs have dawned a new era announcing novel horizons in pediatric airway management.

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