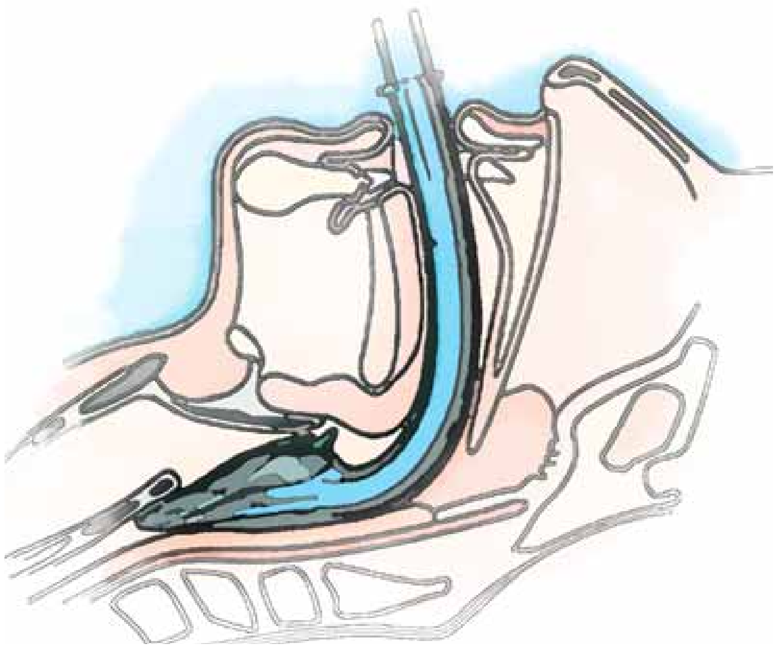
The Supraglottic Airway Device In the Emergent Setting:

Its Changing Role Outside the Operating Room



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The supraglottic airway (SGA) has revolutionized anesthesia practice with its utility as an excellent alternative to mask ventilation and tracheal intubation. Moreover, its role as a rescue device is highlighted not only in the American Society of Anesthesiologists (ASA) difficult airway algorithm but by a multitude of other medical societies' airway management guidelines, as well.[1-3]

The SGA has a proven role in elective and emergency ventilation and oxygenation as well as a conduit for intubating the trachea. The original SGA, now referred to as the LMA Classic (LMA North America), has undergone modifications from the original configuration and design. It now comes in both reusable and disposable models, has gastric drainage (ProSeal, Supreme), and permits intubation (Fastrach). These variations offer:

- Higher sealing pressures for ventilating less compliant lungs and utility in the very ill and obese (ProSeal, Supreme);
- An intubating channel affording a high frequency of successful blind or fiber-optic–assisted tracheal intubation (Fastrach; Figure 1);
- An accompanying port to access the aerodigestive tract for passing an esophagogastric drainage tube (ProSeal, Supreme; Figures 2 and 3).

Many other manufacturers offer duplicates and variations of the original SGA. Practitioners may choose from these many offerings based on price, ease of use, personal preference, or the plethora of publications offering anecdotal support, clinical reviews, and head-to-head

Figure 1. Original reusable LMA Fastrach (above) and the disposable model (below).

Note the metal handle has a different angle compared with the plastic disposable model. This occurred due to multiple uses, coupled with wear and tear.

Case 1: Bronchoscopy in the High-Risk Patient

A 63-year-old man (178 cm, 80 kg) with severe COPD and bilobar pneumonia was admitted to the ward for pulmonary toilet and antibiotic therapy. Oxygen saturation (SpO_2) on room air was 93%.

The patient was transferred to the medical ICU for a scheduled diagnostic bronchoscopy. He received topicalization and light IV sedation with 2 mg of midazolam, but the bronchoscopy was poorly tolerated and the procedure was aborted. The anesthesia team evaluated the patient for sedation-analgesia and airway control. He had not had anything to eat or drink for more than 18 hours and had contraindications to placement of an SGA.

The patient was electively induced in the ICU with IV propofol and a size 4 LMA Classic was placed without incident. Bronchoscopy proceeded uneventfully through the LMA with stable vital signs and SpO_2 greater than 96% at all times. He was awakened on completion of the bronchoscopy and extubated with the return of his reflexes and consciousness.

trials. Some SGAs, such as the i-gel (Intersurgical) and the airQ (Cook Gas), have unique attributes that may potentially improve airway management. Proof of their worthiness in the elective setting is accumulating.

Device evaluation of the SGA and its modifications in the urgent/emergent setting is scant compared with research investigations in the elective setting, case reports, and other publications. The array of modified SGAs has not accumulated sufficient contact with patients to verify their ability to supplant the original SGA in the urgent/emergent setting. However, in a rescue situation, the use of any compatible SGA is recommended.

Data from more than 1,000 published studies attest to the safety, effectiveness, and utility of the LMA. The role of the SGA in the intensive care unit (ICU) and remote location settings spans both elective and emergent situations. These devices can be used to manage patients during procedures using conscious sedation; for the patient who is otherwise difficult to mask-ventilate; in patients prone to airway obstruction or requiring a high level of oxygen support—such as an obese patient with obstructive sleep apnea or one with chronic obstructive pulmonary disease (COPD) or a patient with a lobar pneumonia requiring a diagnostic or therapeutic fiber-optic bronchoscopy (FOB; case 1).[4] Moreover, its use for airway support during both elective and emergent tracheostomy or cricothyrotomy is possible.[5,6]

The SGA can help maintain airway support in patients who require repetitive general anesthetic or moderate to heavy sedation-analgesia during brief ICU procedures (dressing changes, wound debridement, endoscopies, visualization of the airway). Its value in the ICU and remote locations for assistance during emergency airway management is undeniable, particularly during difficult intubation, or when ventilation is impossible or suboptimal with a standard bag-valve-mask (BVM; case 2). Use of an SGA, even by the novice practitioner, as a primary device for ventilation and oxygenation during cardiopulmonary resuscitation/advanced cardiac life support, or when BVM attempts fail, is well supported by the literature.[7-11] Likewise, when tracheal intubation fails during a cardiac arrest, placement of an SGA has a high rate of success and may allow the delivery of improved tidal volumes, higher oxygen levels, and better exchange of carbon dioxide when compared with hand-assisted BVM support.[7-11]

Patient Positioning for SGA Placement

The airway caveat, "make your first attempt the best attempt," is nowhere more applicable than in the urgent or emergent setting. Positioning the patient for primary SGA use therefore should follow rational practice standards.

Optimal positioning is best performed prior to induction, particularly for the obese and patients with short necks, who will benefit considerably by ramping to align the ear canal above the level of the sternum. This position improves the ability to open the mouth for the SGA and enhances mask ventilation and placement of oral airways and laryngoscope blades. It also enables clinicians to apply cricoid pressure, optimize external laryngeal manipulation, and gain access to the cricothyroid membrane and tracheal cartilage (case 3).

Optimizing head-neck-thorax angulation is relatively simple and plays an integral role in airway management. Practitioners who assume their video laryngoscope will

Case 2: All Supraglottic Airways Are Not Identical

A 68-year-old, morbidly obese man with coronary artery disease, congestive heart failure, and COPD underwent right upper- and middle-lobe resection followed by radiation therapy for carcinoma. After surgery, the patient suffered respiratory arrest resulting from pneumonia and required urgent tracheal intubation in the medical ICU.

Because of the man's chronic debilitation, coccyx/sacral stage III wound, and skin breakdown, he was receiving water mattress therapy. The mattress rendered positioning and ramping suboptimal. Past elective intubations were rated as grade I and IIa with DL on separate occasions, with 2-person BVM ventilation documented as "EZ." Induction with propofol and succinylcholine was followed by failed attempts to intubate with DL (grade 4) and a GlideScope (Verathon Medical). The periglottic view was restricted, and clinicians were unable to manipulate the ETT past excessive redundant pharyngeal tissues. BVM ventilation was marginally acceptable with a 3-person effort. A size 4 LMA Fastrach (LMA North America) failed to seat properly, followed by failure with size 3 and 4 LMA Classics. Surgical backup was called while a size 4 LMA Supreme was placed with effective ventilation on the first attempt. Intubation with the combination of FOB, an AIC, and the LMA Supreme was not problematic.

compensate for any positioning defects may become complacent. When their attempts fail and they turn to the SGA, suboptimal positioning may impede rapid and accurate placement of the rescue device.

SGA as a Primary Airway Choice

In an urgent or emergent situation outside the operating room (OR), the clinician's objective is typically to secure the airway through tracheal intubation. For some patients, the SGA may be particularly useful as a primary tool for airway management rather than as a rescue device. It is relatively easy to insert, adaptable to placement with topicalization—with the option to be supplemented with mild sedation and analgesia. It also can bypass manual attempts for patients with assumed or known difficult mask ventilation and act as a laryngeal-trachea conduit for intubation (case 4).

Given the differing cuff configuration and sealing capabilities of the various SGAs, one model may serve to rescue another when the first fails to ventilate or intubate the patient (case 2). Similarly, different manufacturers' products may be mixed and matched to complement each other for a variety of airway management issues.[12-14]

When confronted with the morbidly or super morbidly obese patient, cervical spine immobility, and difficult mask/laryngoscopy/intubation, the SGA is useful for primary management.[15-19] In the urgent or emergent setting, various methods of induction are available. The SGA is adaptable to the awake (topicalized) airway, as well as to the anesthetized, paralyzed patient. In particularly high-risk airway scenarios, quality airway topicalization can be accomplished rapidly (<5 min).[20]

Gargles, gels, and atomized applications of local anesthetic agents, supplemented by explanations to the patient, along with judicious sedation-analgesia (such as 1-2 mg of midazolam and 50-100 mcg of fentanyl) permits the maintenance of spontaneous ventilation in the high-risk patient.

SGA placement is reasonably well tolerated in most cases. Tracheal intubation can then be attempted

Figure 2. Reusable ProSeal model.

Note the separate channels for gastric drainage (lower) and ventilation (upper). Cuff configuration differs from cLMA, for which only the peripheral portion of the cuff inflates. The posterior central portion of the ProSeal cuff expands with insufflation of the pilot balloon improving the airway seal.

Figure 3. Disposable Supreme has the advantage of a preformed curve similar to the LMA-Fastrach, an improved cuff seal, and a gastric drainage portal.

Figure 4. **Close up view of bronchoscope and Aintree catheter.**

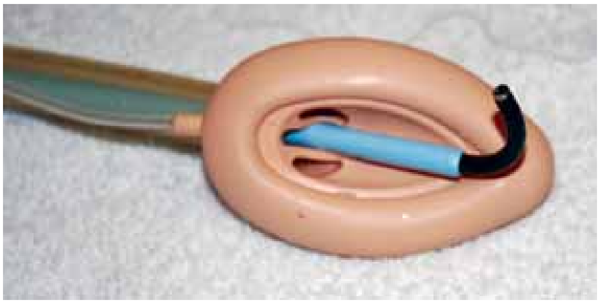

Figure 5. **The tip of a fiber-optic bronchoscope emerging from an Aintree catheter.**

Proper position of the Aintree maintains maneuverability of the distal flexible tip.

Figure 6. **A normal fiber-optic view of the periglottic region from the barrel of a supraglottic airway.**

The leading edge of supraglottic airway is positioned posterior to the glottis in the region of the cricopharyngeal opening.

blindly, with FOB assistance, and with assistance using a combination of FOB and an Aintree intubation catheter (AIC, Cook Medical; Figures 4 and 5).[21-27]

Case 3: Airway Rescue of a Super-Morbidly Obese Patient

A 48-year-old woman (body mass index [BMI] 66 kg/m^2) developed abdominal wound dehiscence with acute respiratory distress. She was bedridden on a bariatric air mattress on the surgical floor, making adequate ramping with towels and pillows a challenge.

The patient's redundant pharyngeal tissues, small mouth opening, and limited orohypopharyngeal cross-sectional area frustrated attempts to intubate in the OR. Airway management under elective conditions and optimal ramping documented difficult 4-person BVM ventilation and 3 attempts with a video laryngoscope.

After consenting the patient, her oral cavity and orohypopharynx were topicalized (atomized spray, 4% viscous lidocaine) with the assistance of a tongue depressor and no sedative-analgesics.

A size 3 LMA Fastrach was passed orally with the physician helping the patient take in the device. Blind intubation was facilitated by the patient taking a deep breath as the silicone, soft-tipped LMA-ETT was advanced into the trachea.

Many clinicians avoid using an SGA in patients with known or suspected distortion of the airway anatomy. Although such a strategy must be determined on an individual basis, the device can be pivotal in establishing effective ventilation when other methods have failed.[28] The shape of the LMA makes it easier to insert in many patients for whom routine direct laryngoscopy (DL) and intubation are difficult. Furthermore, ideal positioning of the LMA in the hypopharynx is not required to provide adequate ventilation (case 5).[29]

An SGA may serve as an adjunct for difficult or failed FOB in either the awake, sedated, or anesthetized patient. It can bypass an enlarged tongue, redundant pharyngeal tissue, or a floppy epiglottis to allow the fiber-optic scope to reach the supraglottic region (Figure 6).[22-27]

SGA as a Secondary Airway Device

The role of the SGA outside of the OR has been revolutionary. International recognition of its versatility is reflected in its inclusion as the main rescue device for ventilation and as an intubation conduit in the ASA difficult airway algorithm and countless other guidelines.[1-3] Although the airway algorithm specifically addresses airway care in the OR, it provides a foundation for developing strategies to avoid difficulties and deal with them when they arise. Nonetheless, the SGA performs 2 key functions as a rescue choice: It has a very high success rate for effective ventilation and oxygenation, and it acts as a conduit for tracheal intubation.

The literature on the utility of the SGA for emergent, urgent, and acute airway care is dwarfed by that

Case 4: Awake Fiber-optic Bronchoscopy in Cervical Spine Trauma

A 36-year-old multitrauma patient with fractures of the cervical spine (C3, C4), clavicles, and ribs experienced hypoxic respiratory failure. Nasal bilevel positive airway pressure (BiPAP) was failing and tracheal intubation was deemed necessary. The patient was suffocating from secretions while in an elevated bed but could not lie flat due to desaturation.

With assistance from the nursing staff, the patient was seated upright. Following explanation of the proposed awake FOB and airway suctioning, topicalization with 4% lidocaine atomized spray to the orohypopharynx was performed. Transcricoid membrane lidocaine was delivered without incident. Nasal BiPAP remained in place.

Despite aggressive FOB suctioning, the placement of an Ovassapian Fiberoptic Airway (Hudson RCI), and jaw thrust, visualization of the periglottic structures was not possible. A size 5 LMA Classic was successfully placed on the first attempt and was well tolerated with no sedative-analgesics. The combination of an FOB and an AIC was successfully passed on the first attempt, followed by AIC-assisted intubation with minimal interference from secretions.

available describing its elective use. However, the few published studies reporting effective ventilation with the LMA Classic and Fastrach suggest a similar rate of success (nearly 100%) within 3 or 4 attempts either in or outside the OR.[25]

Ferson and colleagues reported 100% successful ventilation (within 3 attempts; n=257) with the LMA Fastrach in patients with known or unanticipated difficult airway in the OR (only a few were outside the OR). The overall success rates for blind and FOB-assisted intubations (within 3 attempts) were 96.5% and 100%, respectively.[25] It should be noted that the 5 authors reporting these results had extraordinary training and experience using the LMA Fastrach. As a result, their results may not reflect those of the average practitioner.

In another study, Combes and colleagues reported using the LMA Fastrach as a rescue device in the prehospital setting. They found it provides 100% effective ventilation, and successful blind intubation in 93% of cases (n=45).[30,31] Tentillier et al used the LMA Fastrach as a rescue device in 45 patients outside the hospital with similar results: effective ventilation in 96% of patients and 91% success for blind intubation.[32] Timmermann's group reported 100% success for both ventilation and blind intubation in 11 prehospital cases.[33]

SGA Use in the Acute Setting

Brevity is key to the delivery of airway care in the acute setting. Thus, deployment and execution of an airway management strategy is imperative to limiting patient morbidity and optimizing safety. The 2003 ASA difficult airway algorithm recommends the immediate use of the LMA as a logical next step when faced with failure or inadequate ventilation by mask. The LMA or similar SGA is now the suggested step between mask ventilation and the emergency pathway. If one SGA fails, another may be attempted (case 2). Otherwise, the emergency pathway may be followed.[34-38]

The ASA algorithm and other guidelines offer several options for equipment to use when tracheal intubation proves difficult or impossible by DL. However, these have been rarely scrutinized in a prospective fashion. Several authors have developed simplified strategies to improve airway safety. Streamlining the choice of equipment allows the practitioner to concentrate on a predefined algorithm for management of the unanticipated difficult airway.

Following extensive training of his staff, Combes' group confined airway management during elective surgery to DL, gum elastic bougie, and the LMA Fastrach.[39] When applied in accordance with the predefined algorithm, the bougie and the LMA solved most problems that arose during management of unexpected difficult airways. The same researchers applied their algorithm to the prehospital emergency setting and found that the bougie, LMA, and cricothyroidotomy solved all difficult intubation cases.[37] Successful use of any algorithm must incorporate training with the available equipment so the practitioner has the proper tools to execute such guidelines.[40-44]

SGA Limitations

The most common problem during insertion of an SGA is the failure to achieve correct placement. Despite the relatively high success rate of an SGA, a back-up plan is essential for patient safety.

Case 5: Rescue of Distorted Airway Following Failure of BVM Ventilation and Intubation

A 77-year-old patient underwent carotid endarterectomy under general anesthesia with uncomplicated intubation. Within 4 hours of surgery, a rapidly expanding hematoma led to rapid deterioration and acute airway obstruction. Mask ventilation with 3 people proved difficult, and DL and VL were unsuccessful, the result of extreme hypopharyngeal and periglottic swelling, distortion, and exaggerated lateral displacement of the larynx.

A size 3 LMA Classic was placed followed by effective ventilation and oxygenation, with subsequent surgical decompression at the bedside. DL allowed uncomplicated reintubation of the trachea.

Figure 7. FOB-Aintree being passed through a bronchoscopic swivel adapter on the 15-mm end of the LMA.

A circuit or bag-valve assembly may be attached to the swivel adapter to continue oxygenation during the FOB intubation procedure. Also, with the system "closed" surrounding the FOB-Aintree, positive pressure may be applied to the LMA to assist with viewing the glottic opening.

Figure 8. Aintree catheter deployed within the LMA following removal of FOB.

The next step is to remove the LMA over the Aintree, maintaining its position within the trachea. This is followed by ETT advancement over the Aintree into the trachea.

Difficulty can arise from several recurring issues: inadequate anesthesia or inadequate relaxation, with failure to negotiate the 90-degree turn from the posterior pharynx to the hypopharynx; down-folding or impingement of the epiglottis or other periglottic structures; and folding/distortion of the cuff tip.

Case 6: Failure of Video Laryngoscopy

A patient with multiple traumatic injuries experienced failed rapid sequence induction in the ED. Initial BVM ventilation was successful but deteriorated over several minutes as the anesthesia airway team arrived to place a size 5 disposable LMA Classic.

An FOB was loaded with an AIC. Using the LMA, the combination was advanced to the subglottic region, where the AIC was deployed into the trachea. The FOB was withdrawn. Following removal of the LMA over the AIC and a jaw thrust, a lubricated ETT was advanced easily over the catheter into the trachea. The FOB confirmed the position of the trachea.

Insertion often is easily performed and well tolerated in the patient topicalized with local anesthetic or minimal dosing of sedative-hypnotics or analgesics. The device may be difficult to navigate into the hypopharynx in patients with a small mouth opening, a large tongue, hypertrophied tonsils, or lingual tonsil hyperplasia. However, each of these factors impacts other intubation methods. As a result, the SGA often proves easier to incorporate in these clinical situations than conventional methods of airway control, including DL and video laryngoscopy (VL).

The SGA also may fail as a result of sizing discrepancies, inexperience of the operator, the intrinsic rigidity of the device, its angulation, and other factors. Alignment of the oral-pharyngeal-laryngeal axes or a limited hinge action of the mandible may confound its use. Removal of the front portion of a hard cervical collar, along with midline stabilization, may be required to allow adequate access to the oral cavity.

Pathological changes in the SGA and oropharynx, such as infections, swelling, tumors, or traumatized tissue, may limit successful placement and effective ventilation. Glottic and subglottic narrowing, scarring, stenosis or mass effect also may reduce the rate of success, as can a poorly compliant chest wall and lung parenchymal disease. Airway secretions, blood, edema, and traumatized tissues remain obstacles to overcome. Limiting intubation attempts that may traumatize airway tissues is recommended, as periglottic swelling may cause the SGA to fail because of a narrowed or occluded glottic opening.[45] Use of an SGA before the airway is ravaged by further accumulation of edema and bleeding from intubation trauma is best.[46]

Airway Protection

Successful passing of the SGA beyond the site of oral bleeding can provide airway protection by separating the bleeding site from the lower airway structures (hypopharyngo-laryngo-trachea). Doing so may allow SGA-based methods to facilitate intubation of

Figure 9. Swollen periglottic region with unidentifiable glottic opening.

This picture was taken at atmospheric pressure without the application of positive pressure via the supraglottic airway. One may hesitate to advance the fiberscope forward into an unidentified opening for fear of mucosal damage and creation of a failed channel or lumen.

Figure 10. Same airway as Figure 9 but with a mini-Valsalva pressurization sustained at 8-10 cm H_2O water pressure.

This view illustrates the application of sustained pressure affording lateral displacement of the boggy, overhanging false vocal cords, leading to easy identification of the glottic opening.

the trachea or support ventilation and oxygenation while other options—such as a surgical airway—are considered.

The risk for aspiration with the elective use of SGA approximates that of face masks or endotracheal tubes (ETTs), although it can be expected to be exaggerated in the acute setting.[47,48] Fatal pulmonary aspiration is a rare complication of elective use of an SGA. The esophagus may be exposed to positive pressure, resulting in gastric dilatation and regurgitation. The SGA may be relatively contraindicated in patients with certain anatomical constraints; those at risk for regurgitation or aspiration; and those who have blood, secretions, or other substances occluding the airway.[13,16,17] However, in the urgent or emergent setting, when patient safety is compromised and the airway has not been secured by standard means, an SGA is a reliable option whose risk–benefit profile far exceeds that of the lack of an airway.

Positive Pressure Ventilation With an SGA

In the acute setting, the SGA is not considered to provide a definitive rescue airway but rather a temporary bridge for ventilation or intubation (Figures 9 and 10). Peak inspiratory pressures typically above 20 cm H_2O may displace an SGA, produce an air leak, or insufflate the aerodigestive tract. Some models, including the Fastrach and Supreme, may offer higher sealing pressures. However, most forms of controlled ventilation in critically ill adults routinely achieve pressures above this threshold. Using controlled positive pressure ventilation (PPV) through an SGA in ICU patients is not ideal, although lower levels of pressure for short-term care are possible.[13,16] Therefore, the SGA is best used for the short-term management of the airway with a defined end point—either removal or replacement with a surgical airway, ETT or another airway device.

Intubating SGA

Tracheal intubation through an SGA is viable when conventional methods of intubation prove difficult or impossible. Either blind or FOB-assisted tracheal intubation can be extremely attractive and provides an entirely novel rescue approach when conventional laryngoscopy and tracheal intubation prove problematic. However, it is imperative to understand when blind attempts are appropriate and fiber-optic assistance is required. Blind passage of the ETT through an LMA Classic, for example, has a low rate of success and, more importantly, may cause periglottic tissue injury. Full visualization of the glottic opening through this device is less common than expected despite effective gas exchange.

The SGA is so forgiving that it may work effectively even if it is too deep, too shallow, or at an angle to the glottic opening. Often, the epiglottis is partially or completely folded over (obstructing glottic viewing while allowing unobstructed gas exchange) following deployment of an SGA. Blind advancement of an ETT may be deflected posteriorly toward the pyriform sinus or the esophagus by the overhanging epiglottis or arytenoid. Periglottic tissue injury may generate edema, bleeding, and anatomical distortion that may worsen the airway patency and lead to restricted gas exchange, laryngospasm, and airway obstruction. Subsequent intubation attempts may be severely hampered by these periglottic alterations.

FOB-assisted SGA intubation is an attractive option, but only for clinicians with the proper equipment and appropriate skills.[48] The LMA Classic and similar devices offer a conduit for trachea intubation, although specific details of the intubation process are paramount for patient safety. Passing a standard ETT (6-7 mm) with FOB assistance through the SGA can be readily accomplished. However, the diameter

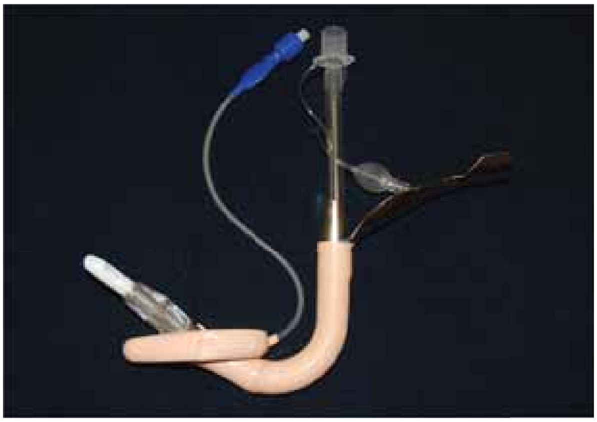

Figure 11. **LMA Fastrach with LMA-ETT emerging in ~35-degree angle that affords consistent alignment with glottic opening.**

Figure 12. **ETT passed in the conventional forward manner via the LMA Fastrach. Note the exaggerated ETT tip angle emerging from LMA.**

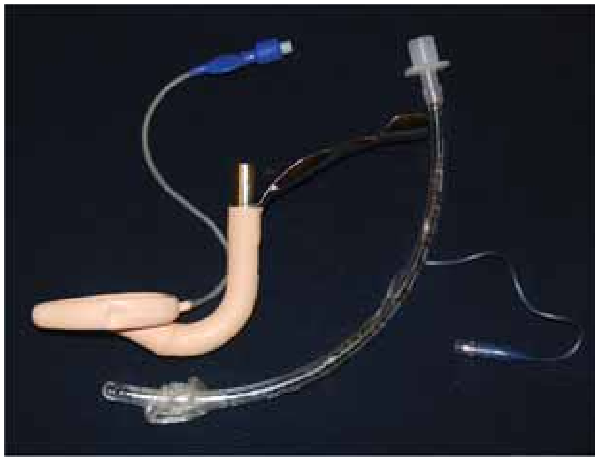

Figure 13. **LMA Fastrach with standard ETT in "forward" approach of ETT insertion.**

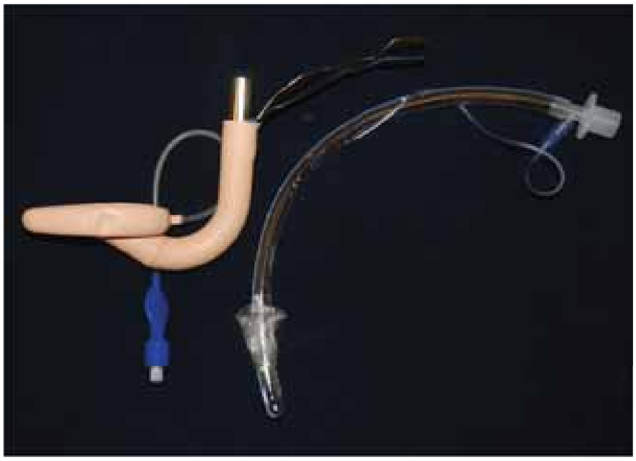

Figure 14. **LMA Fastrach with standard ETT in "backward" approach.**

of the ETT dictates its length. Therefore, the standard 6-mm tube allows the tip-cuff complex to barely exit the SGA inflatable bowl, resulting in a shallow intubation. Although tracheal intubation may be successful, the ETT cuff sits just below the glottic opening or slightly herniated between the vocal cords. Moreover, the ETT is essentially encased within the SGA, making this a temporary fix.

Aintree-assisted Tracheal Intubation

Another helpful technique is pairing an AIC with an FOB to guide tracheal intubation through an SGA.[22,23,37] A bronchoscopic swivel attached to the 15-mm connection of the SGA allows ventilation and oxygenation during the placement of the FOB–AIC combination (Figures 7 and 8). Occasionally, the epiglottis may obstruct the view of the glottis, requiring manipulation of the FOB around the epiglottis or repositioning of the LMA. Redundant pharyngeal and periglottic tissue may restrict visualization of the glottic opening. In these situations, the application of PPV or a Valsalva maneuver may shift the floppy, edematous, mucus-covered periglottic structures to the side and improve glottic visualization (case 8). This "sustained Valsalva" maneuver is possible only when using a bronchoscopic swivel adapter, which allows ventilation through a side port while the FOB–AIC combination is in place.

Applying positive pressure to the airway when confronted with extreme supraglottic edema has been an important adjunct in a small number of high-risk airway patients. Although success is not guaranteed, 8 to 15 cm of positive end-expiratory pressure can lateralize the boggy tissues and permit identification of the glottic opening (author's experience).

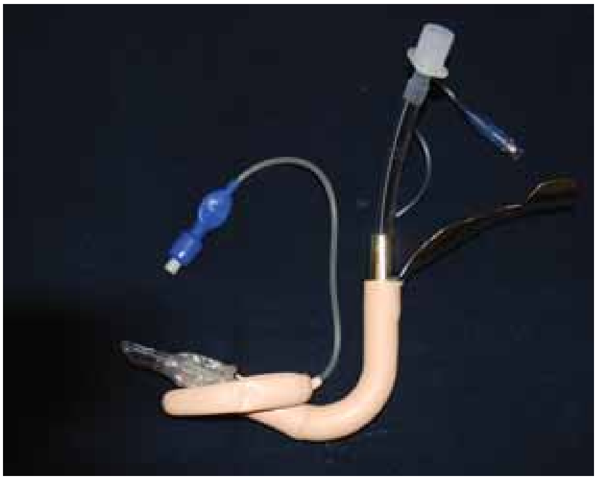

Figure 15. Standard ETT passed "backward" via LMA Fastrach. Note the 20- to 25-degree angle of emergence from the LMA as compared with the 55- to 65-degree angle when passed "forward."

Case 7: Triple LMA Fastrach Save

A 57-year-old woman with a history of hypertension and smoking entered the ED with the chief complaint of bloody vomitus. A significant anterior-lateral myocardial infarction was diagnosed by enzymes, electrocardiogram, and transthoracic echocardiography. The plan was to secure the airway, then perform an upper endoscopy.

The ED team performed a rapid sequence intubation that failed (grade IV view, Mac 3). VL with the C-MAC (Karl Storz) and GlideScope proved difficult because of the patient's exaggerated retrognathia; 1-person mask ventilation was acceptable. After a failed attempt at oral FOB, the anesthesia STAT airway team arrived and placed a size 4 LMA Fastrach on the first attempt with excellent ventilation and oxygenation. A single blind intubation attempt was successful. Endoscopy was performed and the patient was transferred to the medical ICU.

At 8 hours postintubation, the patient was responsive only to deep noxious stimulation, prompting an evaluation of her intracranial contents. While in the magnetic resonance imaging suite, she roused and self-extubated.

Following suboptimal BVM ventilation (SpO_2 of approximately 87%), the anesthesia STAT airway team placed an LMA Fastrach with excellent ventilation and oxygenation. Four blind intubation attempts failed despite resizing and repositioning of the SGA. Flexible FOB failed as a result of unrecognizable anatomy secondary to pronounced mucosal edema, mild bleeding, and copious secretions. A surgical airway was placed concurrent with effective LMA ventilation.

While in the ICU, the patient experienced acute agitation that led to accidental decannulation. Attempts to recannulate the tracheal stoma failed. Mask ventilation led to desaturation to the 60% to 70% range. The airway team arrived and placed a size 4 LMA Fastrach, occluding the stoma with lubricated gauze. PPV allowed visualization of the stomal opening and a new tracheostomy tube was passed with bougie assistance.

LMA Fastrach Intubation

Tracheal intubation with the Fastrach may be accomplished with a variety of ETTs (Figures 11-15). The designated LMA–ETT (size 7, 7.5, or 8) is silicone-based and designed to be used with the Fastrach. The tube construction promotes conformity to the curved component as it exits the LMA, resulting in better alignment with the airway.[25-27] However, a standard ETT may be used if warmed and softened prior to insertion.

At room temperature, the standard ETT should be inserted with tube curving toward the operator, in the opposite manner of how an ETT traditionally is inserted.[49,50] Generous lubrication is a must. A warmed Parker Flex-tip ETT has the advantage of a midline beveled configuration and soft "bird beak" tip.

Blind intubation with the Fastrach has an impressive track record in the elective setting (85%-95% within several attempts). FOB assistance improves the success rate to nearly 100% and is an absolute requirement for intubation with the LMA Classic and its competitors of similar design.[25,49,50] Likewise, following failed blind intubation, therapeutic rescue with FOB assistance is recommended and reliable in skilled hands.

airQ Intubation

The airQ resembles a standard laryngeal airway with added features designed specifically to assist in blind or fiber-optically guided tracheal intubation. It incorporates an esophagogastric decompression port to pass a gastric drainage tube or gastric catheter with an inflatable balloon that acts as a blocker.

The literature supporting the utility, success rates, and limitations of the airQ in a variety of elective and emergency clinical situations is limited. One study found the device useful for blind intubation but significantly less successful than the Fastrach in elective surgery cases (57% vs 95%, respectively).[51]

Training and experience with the airQ is the key to achieving a high success rate. A conventional FOB is easily adaptable to the airQ to assist with advancing the ETT with visualization. Other less-expensive devices that in learned hands may enjoy similar success are the flexible Foley Fast (Clarus Medical) and a similar but rigid stylet that may be placed within the ETT to assist with visualization of the airway during intubation. The recently released aScope (Ambu) is a single-use flexible

Figure 16. **Standard-size fiber scope will often be deflected laterally due to the relative stiffness of the elevator bar, thus making passing and entrance into the glottic opening difficult.**

Figure 17. **To overcome the stiffness of the elevator bar, first advance the ETT to elevate the "bar" (just past the black mark on the LMA-ETT, approximately 17-18 cm depth), then advance the fiber scope through the ETT toward the glottis.**

fiber-optic stylet that resembles a standard FOB. It has a limited image resolution and lacks a suction channel, but preliminary clinical use suggests it may excel as a disposable device.

Figure 18. **ETT emerging from LMA Fastrach as it lifts the "epiglottic elevator bar."**

Case 8: Lateralization of Edematous Airway Tissues Using the LMA Fastrach

A 44-year-old man with a Mallampati score of 1, full range of motion, and a thyromental distance of more than 6 cm, suffered an aneurysmal bleed. Attempted neuro-coiling failed under general anesthesia. Intubation was accomplished with a No. 3 curved blade on the first attempt by a junior anesthesia resident with a reported grade 1 view.

The following day, the patient underwent a successful aneurysmal clipping in the OR and was extubated at the conclusion of the procedure. Within 45 minutes after extubation, his respiration and mental status were deemed suboptimal. The airway team rescured the patient's airway. Following preoxygenation and induction with a combination of propofol and succinylcholine, DL revealed a grade 4 view. VL failed; marked periglottic edema prevented visualization of the glottic opening and advancing of the ETT to the glottis.

BVM ventilation supported oxygenation while a size 4 LMA Fastrach was successfully placed with effective ventilation and oxygenation. Intubation using the Fastrach assisted by FOB was attempted to avoid blind advancement of the ETT. Redundant, edematous tissue layers were noted and the glottic opening could not be identified. A bronchoscopic swivel adapter allowed PPV to lateralize the massively edematous false vocal cords with visualization of the posterior glottis, followed by successful placement into the trachea of the FOB–ETT combination.

Removal of the SGA

Removal of the SGA is not a simple task, especially in the patient with a difficult airway. If the ETT remains confined within the SGA, exchange of the combined devices

Case 9: Supraglottic Failure Followed by Extraglottic Rescue

A 56-year-old woman underwent hemiglossectomy, hemimandibulectomy, and radical neck dissection followed by radiation therapy with subsequent partial laryngectomy and radical neck dissection on the opposite side. Her cervical spine mobility was negligible as was her mouth opening (18 mm). The patient was admitted with recurrent aspiration pneumonia and was scheduled for an elective tracheostomy and gastrostomy tube the following day. While on the ward floor, the patient developed respiratory distress requiring urgent airway management. The anesthesia team prepared to support the airway with BVM ventilation and transport to the OR for urgent surgical access.

During transport in the elevator, rapid deterioration led to intervention that BVM could not overcome. A GlideScope Ranger (Verathon Medical) from the portable airway bag proved difficult to place and revealed only the posterior pharyngeal wall. An LMA Classic failed to seal the airway despite resizing and reseating. This intervention was followed by placement of a Combitube (small adult size) with excellent air exchange and oxygenation. The patient was transported to the OR, where she underwent a lengthy and difficult tracheostomy, with the extraglottic device providing effective ventilation support. Total procedure time was 155 minutes.

typically is performed either at the time of intubation or shortly after the patient is resuscitated and stabilized.

Experience suggests that delaying the exchange of the SGA–ETT combination by between 3 and 12 hours may dramatically exacerbate the difficulty of the airway. Previous airway trauma, aggressive colloid-crystalloid resuscitation, and additional airway manipulation with suction catheters and nasogastric tubes may trigger formation of periglottic edema.

At times, the patient's physical condition may not allow the airway to be manipulated, especially after a trying airway encounter. Experienced personnel may not be immediately available to assist with the SGA exchange.

The removal of an LMA Fastrach from the indwelling ETT can be challenging, even in the most experienced hands. If the patient's condition does not permit prompt removal or skilled personnel are not at the bedside, a delay in removal may be warranted. However, time is an enemy and at a minimum, the cuff of the Fastrach should be deflated to lessen mucosal damage and it should be removed within 3 hours.

Surgical Airways and the SGA

The SGA has a close relationship with the emergent or urgent surgical airway. In the past, a surgical airway was commonly performed when ventilation and intubation had failed. Surgical access was begun with gross instability, extreme hypoxemia, and perhaps even cardiac arrest with chest compressions ongoing. In these same cases today, many patients may still warrant a surgical airway but with concurrent SGA support (case 7). The author has been personally involved in 14 cases of emergency placement of a surgical airway over 20 years; all but 1 had concurrent SGA support of ventilation and oxygenation without cardiopulmonary arrest.

Deployment of the SGA in the Acute Setting

The use of an SGA in remote locations outside the OR for emergent and urgent care is well entrenched for many airway specialists. Distribution of these devices outside the OR can be balanced between static sources—the code cart on the surgical ward or difficult airway cart in the medical ICU—that can be moved to local areas of need. Or they can be kept in transportable airway bags or tackle boxes carried by the airway team to the patient's bedside. This latter option is especially adaptable to cardiac arrests and airway emergencies that occur in cafeterias, lobbies and other areas not dedicated to patient care (case 9).

Cooperation between departments to develop and sustain the logistics of restocking and maintenance of SGAs is a must. The availability of these devices requires an institution-wide acceptance of a standard of care that originates in the OR and encompasses all areas of patient care.[1-3]

Conclusion

The SGA has a proven role in the management of anticipated and unanticipated difficult intubations in the OR, cases of cervical spine injury, the obese, and in patients with obstructed airways. Its dual role as a ventilating device and intubation conduit is unparalleled. Literature in the ICU, remote hospital locations, prehospital, and emergency department (ED) is limited but appears favorable to support their continued use in these settings. The SGA is an important element of published airway management guidelines and algorithms. Complications related to their use appear to be uncommon. These low-cost items will serve the patient and institution well.

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Review of the Author's Use of Supraglottic Airways in the Acute Setting

The use of the SGA in the emergent setting has been overwhelmingly successful in the author's institution. These devices have saved countless lives based on rescue ventilation and intubation. However, they have limitations, despite the findings from Ferson et al (Table 1).[25]

Obviously, this review covers a patient population different from Ferson's mainly elective use of the Fastrach in difficult airway patients in the OR. A sampling of the emergency intubation database at Hartford Hospital shows a high success rate for effective SGA ventilation, blind intubation with the Fastrach and fiber-optic–guided ETT intubation through either a Fastrach or LMA Classic.

The rate of success varied by the clinician's level of experience and training. Patient preparation included topical anesthesia (20%), propofol (38%) midazolam (10%), etomidate (32%); 17% received neuromuscular blocking agents. Most patients were overweight or obese; 63% had a BMI greater than 30 kg/m^2. Most had limited (56%) or no cervical (27%) range of motion. Primary use of an SGA (vs rescue) occurred in 61 of 319 cases (19%); 44% had a known difficult airway and 56% had a suspected difficult airway.

Any airway management strategy must consider alternative methods when the primary choice proves inadequate, difficult, inappropriate, or fails. The SGA has undergone a changing role with the introduction of VL technology. Previously, the SGA was the most likely rescue device if DL or a combination of DL and a bougie failed. If the SGA failed, VL became the rescue choice (Table 2). Practitioners now aggressively use VL as their primary method or as a rescue device after failed DL; the SGA serves as the VL backup. Educational efforts to maintain the required skill set for advanced SGA devices and techniques is imperative toward patient safety. Reliance on VL technology has permeated clinical practice at the expense of deteriorating competence in advanced SGA techniques. It is warranted to remain abreast with both, as they compliment each other.

Table 1. Hartford Hospital Emergent/Urgent Airway Care With SGA (N=319)

	LMA Classic, % (n=64)	LMA Fastrach, % (n=255)
Ventilation (up to 3 attempts)	95.7	92
Blind intubation (up to 3 attempts)	—	88
First attempt success–blind	—	68
Fiber-optic–assisted intubation	97	77
First attempt fiber-optic–assisted	79	73
Esophageal intubation	7	14

Table 2. Rescue Devices Following LMA Failures

LMA Ventilation Failures (No. of Cases)	LMA Intubation Failures (No. of Cases)
DL (1)	DL–Bougie (3)
DL–Bougie (1)	Combitube (10)
FOB (1)	VL (24)
Combitube (6)	
VL (15)	

DL, direct laryngoscopy; **FOB,** fiber-optic bronchoscopy; **VL,** video laryngoscopy

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