Use of Supraglottic Airways (SGAs) as Rescue Devices, Conduits for Tracheal Intubation (TI), and Other Special Cases

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KEY POINTS

- SGAs can bridge the gap between facemask ventilation and TI, allowing ease of use and high success rates.
- Second-generation SGAs improve patient safety with integrated gastric ports and higher sealing pressures, reducing the risk of aspiration; third-generation SGAs include additional video capabilities.
- SGAs are a critical tool in challenging airway scenarios, serving both as rescue devices and conduits for fiberoptic TI.
- Suboptimal SGA placement can increase the risk of pulmonary aspiration and ventilation failure; third-generation SGAs can improve placement success by allowing visualization and continuous monitoring of airway positioning.
- Choosing between single-use and reusable SGAs involves weighing environmental impact against cost and resource consumption.
- SGAs can be used in specialty scenarios like obstetrics, bariatrics, laparoscopic procedures, and prone positioning on a case-by-case basis after taking necessary precautions.

INTRODUCTION

In the 1980s, Dr. Archie Brain invented the first supraglottic airway device (SGA), providing a middle ground between face-mask (FM) ventilation and tracheal intubation (TI). Initially used as rescue airways, SGAs eventually gained wide adoption in various settings, most notably in prehospital ventilation and elective surgeries lasting up to 2 hours. Its popularity stemmed from its ease of use and high success rate compared to laryngoscopy and TI in routine and rescue settings.[1] SGAs allow for easy alveolar oxygenation (AO), minimal sympathetic response, lower incidence of sore throat, fewer postoperative complications compared to TI, and preservation of the mucociliary escalator.[2]

This tutorial focuses on the different generations of SGAs, their use as rescue airways and conduits for TI, optimal placement techniques, environmental considerations of single-use versus reusable devices, and various clinical applications.

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First-Generation SGAs

First-generation SGAs, such as the LMA Classic (Teleflex), LMA Flexible (Teleflex), Ambu Aura-Once (Ambu), and LMA Fastrach, share a primary design consisting of a ventilation barrel with an inflatable cuff. However, they offer little protection from gastric aspiration and have limited utility in patients with increased airway resistance due to lower seal pressures. Among first-generation SGAs, only the LMA Fastrach was designed to facilitate TI and incorporates an integrated bite block (see Figure 1).

Second-Generation SGAs

Second-generation SGAs include the LMA ProSeal (Teleflex), LMA Supreme (Teleflex), LMA Protector (Teleflex), LMA CTrach (Teleflex), Ambu Aura-i (Ambu), Ambu AuraGain (Ambu), Air-Q (Mercury Medical), Air-Q Blocker (Mercury Medical), Baska Mask (BVLM), and Total Track (MedComflow). These devices include an integrated gastric port that decompresses the stomach and reduces aspiration risk. Despite this, patients with suspected gastric contents should not be managed with an SGA unless required. These devices also often feature curved barrels to improve placement success, integrated bite blocks, and larger cuff surface areas for a better seal (see Figure 2).

Third-Generation SGAs

Third-generation SGAs combine second-generation SGA features with integrated video capabilities. Currently available third-generation SGAs include the Video Laryngeal Mask (SaCo), UESCOPE 2 (UE Medical Devices), and the Safe VLM (Magill Medical Technology Co. LTD). These devices have cameras at the distal end of the ventilation barrels, allowing visualization of the laryngeal structures to guide placement and allow continuous position monitoring.

Studies show that direct visualization during SGA placement improves the rate of appropriate positioning. In one study, SGA placement visualized with direct laryngoscopy achieved appropriate positioning in 91.5% of patients, compared with 42% with blind insertion.[3] Although studies on third-generation SGAs are limited, it is reasonable to expect that video guidance would similarly improve placement. Third-generation SGAs can also be used as conduits for TI without requiring a fiberoptic bronchoscope. The camera can provide visual confirmation of TI, though some clinicians may still prefer using a flexible bronchoscope for its maneuverability (see Figure 3 and Figure 4).

SUPRAGLOTTIC AIRWAYS AS RESCUE AIRWAYS AND CONDUITS FOR INTUBATION

Preoperative Evaluation

When deciding on SGA use, aspiration risk, airway examination, and history of airway pathologies should be assessed. Aspiration risk depends on NPO status, gastroesophageal reflux disease history, gastroparetic medications, and potential

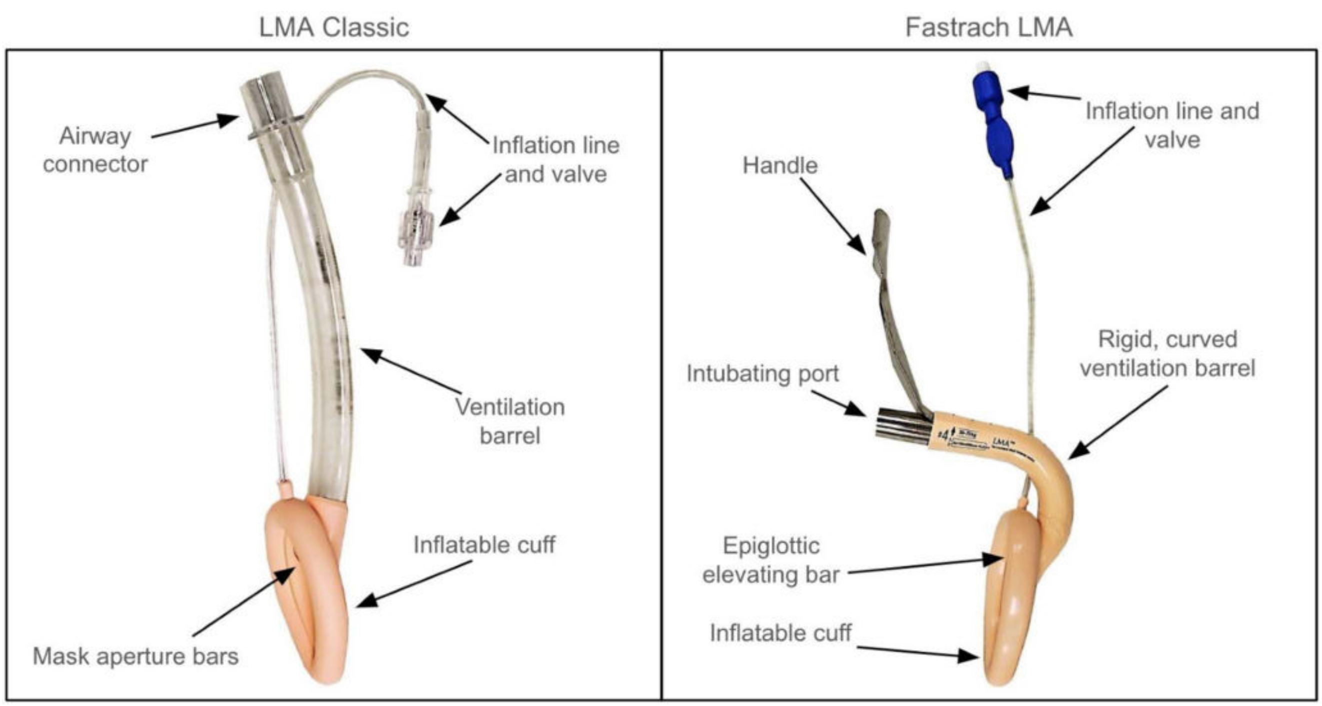

Figure 1. Common first-generation SGAs.

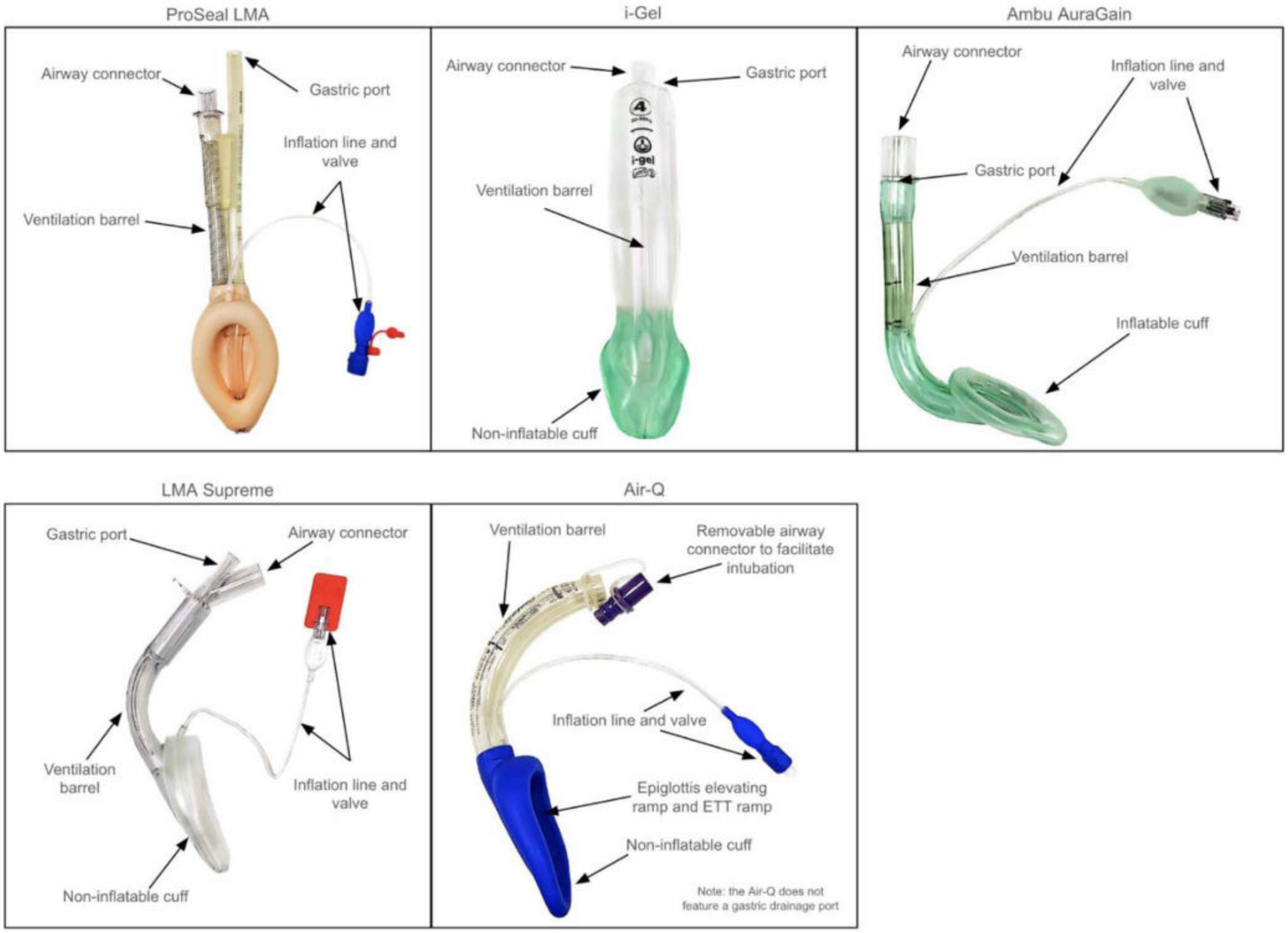

Figure 2. Common second-generation SGAs.

gastric ultrasound. Airway examination includes mouth opening, tongue shape, dentition, thyromental distance, cervical spine mobility, and any history of airway pathologies. For patients with decreased thyromental distance, an SGA with a highly angulated ventilation barrel may facilitate insertion. Numerous airway pathologies (extraglottic, glottic, and subglottic) can complicate SGA placement and are listed in the table below[4] (see Table).

SGAs in the Management of Difficult Airways

The 2015 Difficult Airway Society (DAS) and the 2022 American Society of Anesthesiologists (ASA) Guidelines emphasize using SGAs in re-establishing AO in “Can’t Intubate, Can’t Oxygenate” (CICO) scenarios. A “difficult airway” is defined here as any situation where an anesthetist encounters difficulty or failure with any airway management techniques.

The 2015 DAS Guidelines recommend preoxygenation with FM ventilation and up to three TI attempts, with a possible fourth attempt by a most experienced colleague.[5] A failed TI is declared if this fails, and SGAs are the first-line devices to re-establish AO. In contrast, the 2022 ASA Algorithm for Adults does not specify a fixed number of TI attempts, and it recommends the SGAs for rescue only if FM ventilation is inadequate after failed TI.

FM ventilation after a failed TI may be hindered by airway edema and trauma.[6] SGAs are effective in airway rescue because they bypass anatomical constraints of FM ventilation and TI, such as achieving an adequate glottic view, a sufficient mouth opening of at least two finger breadths/2 cm, and a proper mask seal.[4] Their ease of use allows them to rescue many challenging airway scenarios, with one observational study demonstrating a 94.1% success rate of SGAs for rescuing failed FM ventilation and TI.[1] The 2015 DAS guidelines recommend a maximum of three attempts at SGA insertion to minimize trauma. If unsuccessful, attempting FM ventilation is recommended before progressing to emergency front-of-neck access (eFONA). When reattempting FM ventilation, clinicians should consider neuromuscular blocking agents and a two-person ventilation technique. If SGA placement results in sufficient AO, clinicians will have time to consider these possible next steps:

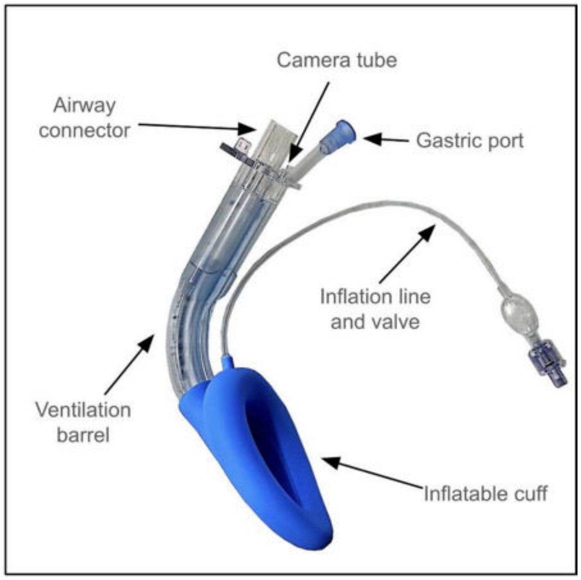

Figure 3. A third-generation SafeLM (Magill).

1. Maintain the SGA as the primary airway.
2. Conversion to an infraglottic airway.
3. Wake up the patient.
4. Proceed to surgical airway (eFONA).

Key factors to consider are the quality of ventilation and AO through the SGA, aspiration risk, length and urgency of the procedure, and available equipment.

SGAs as Conduits for Tracheal Intubation

Many SGAs are useful as conduits for TI, especially when managing complex airway anatomy or in emergencies where conventional methods have failed. TI through SGAs can be performed using SGA-guided flexible fiberoptic bronchoscopic intubation (SAGFBI), which includes direct and indirect methods, or blind intubation using a flexible bougie.

A fiberoptic approach increases the first-pass success rate and reduces complications. One study comparing the LMA Fastrach found a 75.5% first-pass success rate for blind intubation (overall 96.5% within three attempts), whereas SAGFBI

Figure 4. A third-generation SGA in use.

Extraglottic Pathologies	Glottic Pathologies	Subglottic Pathologies
Limited mouth opening	Vocal cord paralysis	Subglottic stenosis
High arched palate	Laryngeal tumors/masses	Tracheal tumors/masses
Palatine torus/other tumors	Laryngospasm	Tracheomalacia
Macroglossia	Laryngomalacia	Bronchospasm (the only airway reflex that cannot be blunted with use muscle relaxants)
Tonsillar hypertrophy	Vocal cord polyps	Pulmonary fibrosis
C-spine abnormalities	Laryngeal stenosis	Tension pneumothorax
Obesity		
Congenital deformities		
Facial trauma		
Orthodontic appliances		

Table. Pathologies that can Interfere With Optimal SGA Placement

achieved a 100% first-pass success rate. Due to lower first-pass success rates and higher risk of trauma and esophageal intubation, blind intubation through an SGA should not be attempted if SAGFBI equipment is available.

The direct SAGFBI method requires an SGA with a ventilation barrel wide enough to accommodate an ETT. For a size 6.0 ETT, using a micro laryngeal ETT is advisable, as its longer length prevents cuff inflation at the vocal cords.[7] The indirect SAGFBI method, which requires an Aintree Intubating Catheter (AIC), is helpful when the SGA's ventilation barrel is too narrow to accommodate the ETT. Using an AIC allows railroading of a larger ETT, like a size 7.0.

Direct SGA-Guided Flexible Bronchoscopic Intubation[8]

1. Gather a fiberoptic bronchoscope, ETT, and SGA. Ensure that the equipment sizes are compatible.
2. Preload the ETT onto the bronchoscope.
3. Insert the SGA and confirm its placement following standard protocol.
4. Insert the bronchoscope/ETT unit through the ventilation barrel of the SGA, advancing through the glottis and trachea until the carina.
5. Railroad the ETT over the bronchoscope and into the trachea to the desired depth.
6. Remove the bronchoscope and inflate the ETT cuff (see Diagram 1).

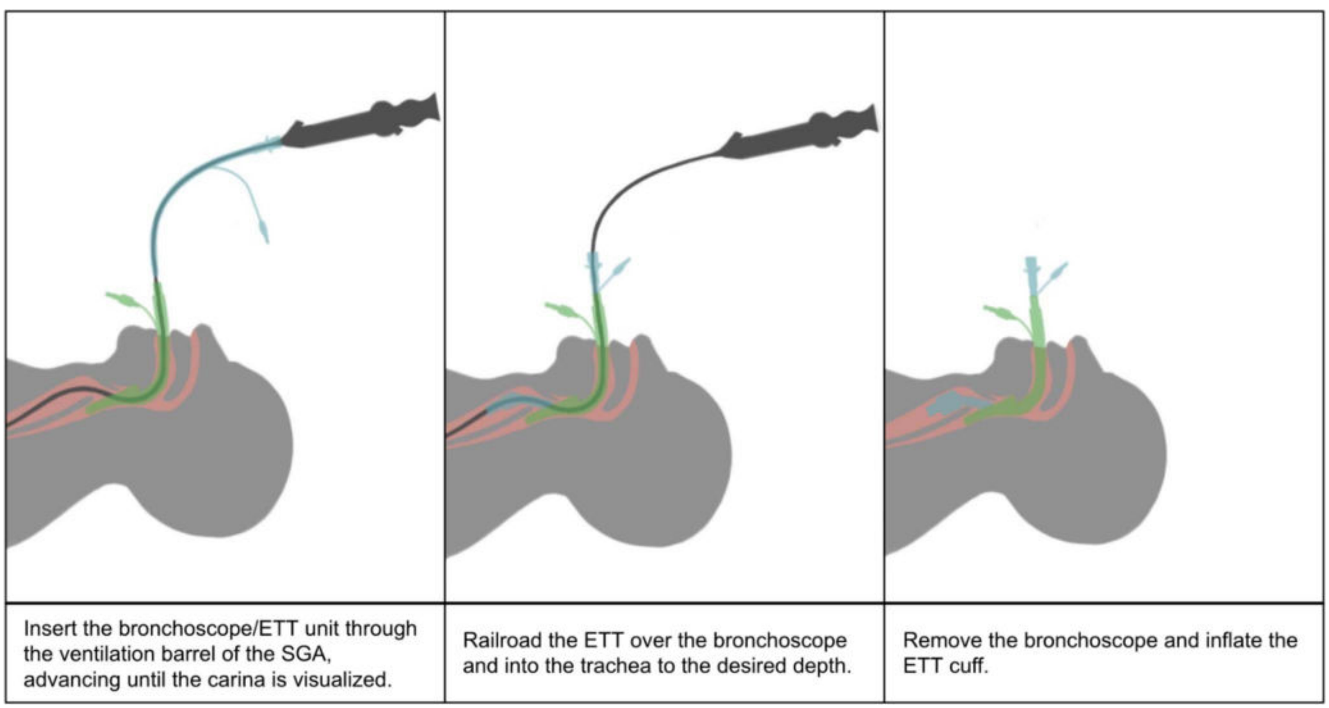

Diagram 1. Direct Supraglottic Airway-Guided Fiberoptic Bronchoscopic Intubation (SAGFBI).

Indirect Supraglottic Airway Guided Flexible Bronchoscopic Intubation[8]

1. Gather a fiberoptic bronchoscope, Aintree Intubating Catheter (AIC), ETT, and SGA. Ensure that the equipment sizes are compatible.
2. Preload the bronchoscope with the AIC.
3. Insert the SGA and confirm its placement following standard protocol.
4. Insert the bronchoscope/AIC unit through the ventilation barrel of the SGA, advancing through the glottis and trachea until the carina is visualized.
5. Withdraw the bronchoscope.
6. Carefully remove the SGA while keeping the AIC in the trachea.
7. Railroad the ETT over the AIC into the trachea to the desired depth.
8. Remove the AIC and inflate the ETT cuff.
9. Use the fibreoptic bronchoscope to re-confirm accurate TI placement (see Diagram 2).

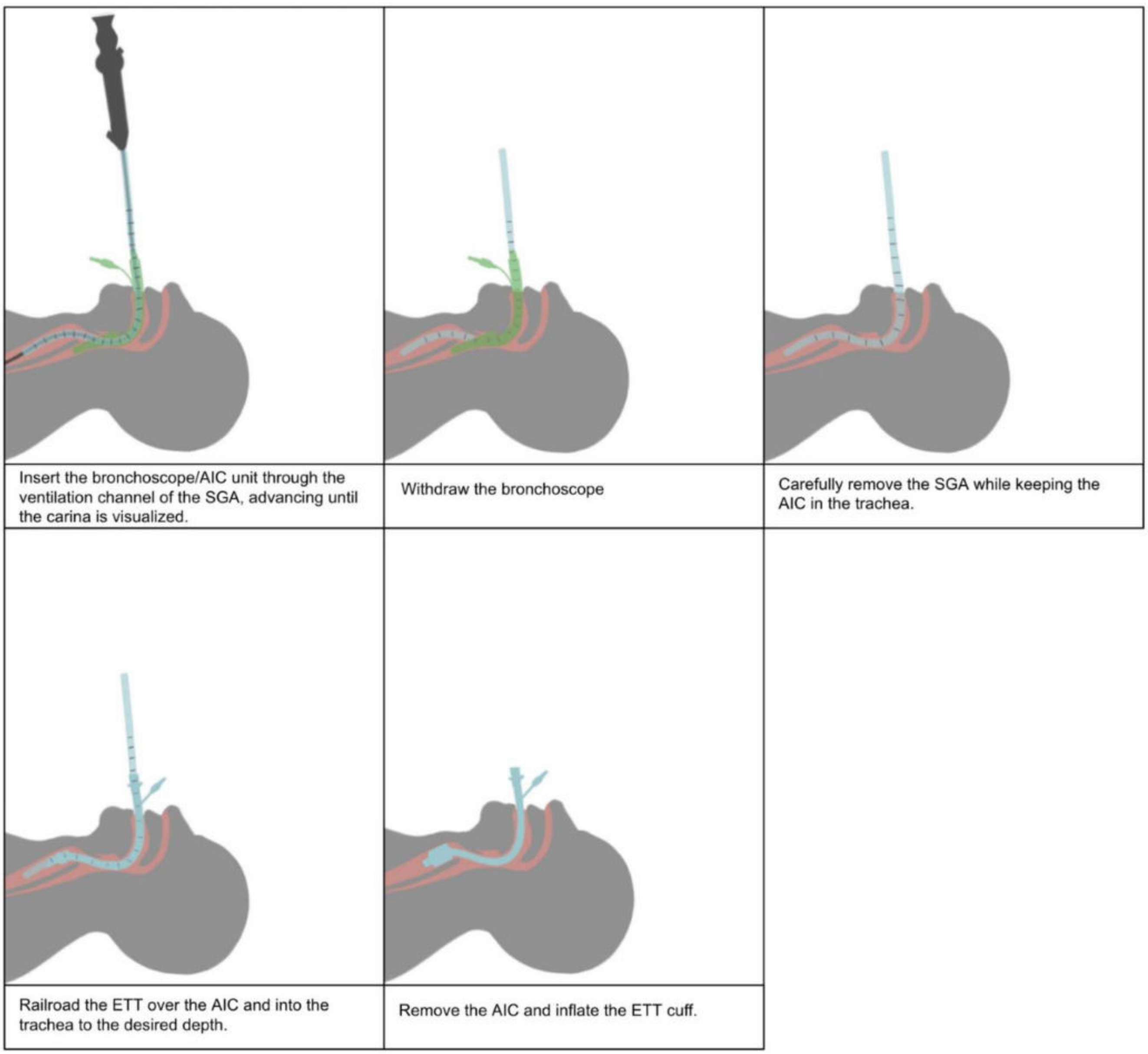

Diagram 2. Indirect Supraglottic Airway-Guided Fiberoptic Bronchoscopic Intubation (SAGFBI).

After performing direct SAGFBI, it is recommended to leave the SGA in situ with a deflated cuff to prevent prolonged mucosal pressure and avoid accidental tracheal extubation during removal. If removing the SGA becomes necessary, such as for surgical examination after airway trauma, the following steps should be taken to prevent accidental extubation.[5]

1. Remove the ETT connector and deflate the SGA cuff.
2. Anchor the ETT by inserting an LMA Fastrach stabilizer rod or a long microlaryngeal tube into its proximal end, or hold the ETT with a Magill.s forceps.
3. Once the ETT is secured, carefully remove the SGA.

Devices Suitable for Use as Conduits for Tracheal Intubation

Several SGAs are specifically designed to function as conduits for TI, including the classic LMA™, i-gel™ AuraGain™ Air-Q® and LMA Protector™[9]. Characteristics that make these SGAs suitable for intubation include:

1. Larger diameter and shorter ventilation lumen: A wider diameter and shorter ventilation barrel allows passage of an appropriately sized ETT.
2. Higher angulation: The highly angulated ventilation barrel aligns the ETT with the trachea and improves intubation success, especially in anterior airways.
3. Epiglottis elevating mechanisms: Mechanisms such as a V-shaped elevation ramp or epiglottis elevating bar in the cuff prevent epiglottic downfolding and obstruction.

Optimal SGA Placement

Optimal Placement and Seals

Optimal SGA placement requires two seals.[4] The respiratory seal between the SGA cuff and laryngeal inlet ensures that ventilation is directed into the trachea; an insufficient seal can lead to ventilation failure, air leak, or airway obstruction. The esophageal seal between the cuff and esophageal inlet provides some protection against gastric insufflation and aspiration.

Common SGA Misplacements

Imaging studies show that SGA mispositioning occurs in 50%–80% of SGA placements, but suboptimal placement still generally provides a clinically acceptable airway.[4] Seven common mispositions have been identified: epiglottic downfolding, infolding of aryepiglottic folds, sagittal plane rotation, cuff fold-over, glottic distortion, distal/proximal cuff misplacement.[4] For more details about common SGA mispositions, you may scan this QR code:

Methods to Confirm Placement

The primary method of confirming adequate SGA placement is by monitoring respiratory mechanics. The gastric drainage channels of second-generation SADs can also provide helpful information about SGA placement, and several clinical methods have been described, including the gastric tube bubble test, suprasternal notch tap test, and gastric tube insertion test.[10] For more details about performing these tests, you may scan this QR code:

Environmental Considerations

Reusable SGAs are made from materials that can withstand a harsh sterilization process. However, using reusable SGAs beyond the manufacturer's recommended limit can mechanically degrade them and potentially lead to complications.[11] Single-use SGAs should never be reused, as they are not designed to withstand sterilization, and insufficient sterilization increases the risk of cross-infection.[12]

The choice between single-use and reusable SGAs is unclear environmentally and economically. Reusable devices reduce medical waste, but sterilization is resource intensive. The cost of reusable devices includes the expenses of sterilization and the difficulty of tracking their usage, though some of these challenges may be mitigated by outsourcing sterilization to companies that reprocess medical equipment. The choice between single-use and reusable SGAs should be considered on an institutional basis.[12]

Special Scenarios

SGAs in Obstetric Anesthesia

Airway management in obstetric patients is challenging due to the physiological and anatomical changes of pregnancy. Using SGAs in these patients risks bleeding, the loss of airway patency due to edema, or SGA dislodgement, all of which may necessitate eFONA. Obstetric patients are also at greater risk of gastric aspiration, though the incidence is still relatively low (<1:1000).[13] Risk stratification should account for factors like BMI, NPO status, airway evaluation, and gastric point-of-care ultrasound, though the image will be altered by the gravid uterus.

To mitigate these risks, the DAS and the Obstetric Anaesthetists' Association recommend using second-generation SGAs for airway maintenance and as rescue ventilation after failed TI in obstetric patients.[14] Furthermore, SGAs have been shown to cause fewer post-extubation complications than TI, which is particularly important in obstetric patients due to increased mucosal friability.

Bariatrics

Airway management in bariatric patients is challenging due to anatomy, increased parapharyngeal soft tissue, difficult FM ventilation, and decreased apnea time. Early SGA placement secures the airway and avoids desaturation and gastric insufflation from inadequate FM ventilation. After placement, the SGA can be used as a conduit for TI, with the ETT being used for most of the case. Before emergence and the reversal of paralysis, the trachea can be extubated, and the SGA reinflated as the primary airway. This reduces hemodynamic instability, reduces post-extubation complications, allows better-controlled emergence, and permits awake removal of the SGA.

Outside of rescue situations, SGAs should generally be avoided in elective and emergency abdominal procedures in morbidly obese patients due to increased aspiration risk. In obese patients, a 30° head-up tilt during SGA placement and pressure-controlled ventilation are also recommended to optimize respiratory mechanics.

Percutaneous Tracheostomy

Patients undergoing percutaneous tracheostomy are typically intubated, but ETTs can introduce difficulties during the procedure.[15] The ETT must accommodate a fiberoptic bronchoscope during the procedure, which can increase airway pressures and limit flow rates. Furthermore, one portion of the procedure requires deflation and withdrawal of the ETT. If the tracheostomy fails, reintubation may be difficult due to complications like tracheal stenosis or airway edema. Using an SGA instead of an ETT can circumvent these issues. They have a wider ventilation barrel to accommodate the fiberoptic bronchoscope, and they can remain in situ throughout the procedure without interfering with the surgical field.

Ventilation Through Tracheal Stomas

SGAs may be used to ventilate patients with mature tracheal stomas, including patients with tracheostomies or laryngectomies. Before attempting ventilation, it is essential to assess the maturity of the stoma. Stomas are typically considered mature after 7 days post-surgery. If the stoma is mature, a pediatric-sized face mask or small SGA can be placed over it to form an airtight seal for ventilation. The mouth and nose should be occluded to prevent air escape, except in laryngectomy patients where the upper and lower airways are separated.

Pediatric Airways

Children with congenital airway-compromising conditions like Goldenhar Syndrome, Pierre Robin Sequence, Treacher Collins Syndrome, Klippel-Feil Syndrome, Crouzon Syndrome, and Down Syndrome present with difficult airways. In these cases, SGAs with or without topicalized local anesthesia can be used to achieve rapid airway control and can serve as conduits for TI. Additionally, SGAs may be used in tonsillectomy and adenoidectomy, decreasing airway stimulation upon extubation and reducing the risk of laryngospasm.

Prone Positioning

SGAs may be used in certain procedures requiring prone positioning after considering patient risks, anaesthesiologist experience, and formal agreement between with the surgical team. Suitable procedures include liposuction, interventional radiology procedures, haemorrhoidectomy, lower limb orthopaedic surgeries, perianal or gluteal abscess drainage, and specific chronic pain procedures that require deep sedation where TI may be avoided.

Allowing the patient to assume the prone position before induction can reduce the risk of pressure points and nerve injuries associated with repositioning after anaesthesia. Once the patient is comfortably prone, consider titrating induction while ensuring the ability to perform FM ventilation. It is crucial to have a plan to turn the patient supine if airway management fails. Additionally, if accidental extubation occurs, an SGA can re-establish the airway while remaining prone.

Laparoscopic Surgery

SGAs have been increasingly adopted in laparoscopic surgical procedures, especially laparoscopic cholecystectomies. They offer advantages over TI, including easier placement, reduced neuromuscular blockade, lower cardiovascular instability, preservation of mucociliary clearance, and fewer postoperative airway complications. Second-generation SGAs are strongly preferred in laparoscopic procedures because they protect against pulmonary aspiration and can achieve higher sealing pressures. The decision to use an SGA depends on factors like team communication, insufflation pressures, patient positioning, surgery duration, and aspiration risk.

SUMMARY

Supraglottic airway devices (SGAs) are an essential tool in modern airway management, providing a middle ground between face-mask ventilation and tracheal intubation. They have gained widespread use as primary airways and are a critical part of difficult airway algorithms due to their ease of insertion and their ability to serve as conduits for fiberoptic intubation. Optimal device selection will depend on the clinical context, with second-generation SGAs allowing for higher sealing pressures and the ability to decompress the stomach, and third-generation SGAs adding video guidance for insertion and intraoperative monitoring. SGAs have various uses in special scenarios, but their benefits should be weighed against their decreased airway security based on the patient and procedural risk factors.

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