Abstract:
Supraglottic airway (SGA) devices have been shown to be a critical tool in pediatric airway management. The role of the SGA in emergency scenarios has increased dramatically, as its advantages are widely recognized. Studies have shown that SGAs are safe and effective in providing lifesaving oxygenation and gas exchange in both the normal and difficult pediatric airway and during resuscitation. They allow for rapid oxygenation and ventilation in the vast majority of children and are the ideal rescue device for failed facemask ventilation. They are also the ideal conduits to facilitate tracheal intubation. Newer SGA devices have design features to overcome limitations found in older devices. This narrative review aims to discuss the role of SGAs for pediatric emergency medicine.

Keywords:
supraglottic airway; pediatrics; emergency medicine; airway

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The Role of Supraglottic Airways in Pediatric Emergency Medicine

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Supraglottic airways (SGAs) are devices that sit immediately outside the larynx and provide potentially lifesaving oxygenation and gas exchange in both the normal and difficult pediatric airway and during resuscitations. They have been shown to be a critical tool in pediatric airway management. The role of the SGAs in emergency scenarios has increased dramatically, as their safe and effective use has become widely recognized.

PEDIATRIC AIRWAY ANATOMY AND RELEVANT PHYSIOLOGY

Management of the pediatric airway poses its own unique challenges compared with the adult airway. Anatomically, small children have a more cephalad larynx, floppier "U"-shaped epiglottis, larger tongue, smaller mouth opening, and are more prone to rapid oxygen desaturation due to their higher rates of oxygen consumption. In addition, their hypopharynx is shorter and narrower than adults, and their lung compliance is high, so less peak airway pressure is needed to achieve adequate tidal volumes.

As children grow, their airway anatomy undergoes important transitions. The larynx slowly descends from its original position

high in the neck, the pharyngeal space increases, the orientation of the vocal cords changes (which can affect ease of advancement of an endotracheal tube), the prominence of the occiput decreases, and the rate of oxygen consumption decreases. These changes occur largely over the first 2 years of life. Recognizing these changes and differences can significantly affect the use of SGAs.

The large occiput in the small child predisposes them to airway obstruction because the neck is flexed when lying supine. The larger tongue and shorter mandible can also contribute to airway obstruction. Appropriately placed SGAs can effectively alleviate this airway obstruction.

Conversely, an incorrectly placed SGA in infants and children can lead to problems including poor sealing, movement and dislodgement of the mask, compression of glottic structures, reflex activation of the airway, and gastric insufflation. A malpositioned device can cause or worsen airway obstruction, often secondary to compression of structures such as the epiglottis. In addition, a malpositioned SGA increases the risk of gastric insufflation, which can have profound detrimental effects on ventilation (more so than the adult patient).

Pediatric SGAs have design features to accommodate for the anatomic and physiologic differences seen in children. Newer devices have stiffer mask bowls to reduce folding of the mask tip, shorter and wider airway tubes to facilitate tracheal intubation, and access channels to allow gastric decompression.

SUPRAGLOTTIC AIRWAY BASIC PRINCIPLES

Supraglottic airways can be subdivided into 2 categories—those that form a perilaryngeal seal, such as Laryngeal Mask Airway (LMA) (Teleflex, San Diego, CA), air-Q (Mercury Medical, Clearwater, FL), and i-gel (Intersurgical Inc, Liverpool, NY) and those that form a pharyngeal seal, such as the Combitube (Covidien Medtronic, Minneapolis, MN) and laryngeal tube. Supraglottic airways can further be classified as first- or second-generation devices.

Perilaryngeal Sealers

First-generation devices consist of an airway tube and simple mask, which provide a perilaryngeal seal. Second-generation devices also provide a perilaryngeal seal with the addition of a built-in gastric drain port, which allows for evacuation of gastric contents, which may reduce the risk of regurgitation and pulmonary aspiration. The hypopharyngeal seal is a second seal formed from the leading edge of the device resting against the upper esophageal sphincter. Second-generation SGAs typically provide a better hypopharyngeal seal, resulting in more effective positive pressure ventilation as measured by airway leak pressures. Airway leak pressures are a surrogate marker of airway seal, which is a common parameter tested when assessing SGA clinical performance as a ventilatory conduit.

Pharyngeal Sealers

Pharyngeal sealers are also called esophageal blockers. They consist of an airway tube with 2 inflatable cuffs—a distal cuff to seal the esophagus and a proximal cuff to seal the hypopharynx—and a ventilation outlet between the 2 cuffs. There are first- and second-generation laryngeal tubes (second-generation ones, like perilaryngeal sealers, have a built-in gastric channel for placement of tube to allow gastric drainage). Typically, these devices are used in scenarios that are in settings that are out of the hospital/operating room, often by prehospital providers.

SUPRAGLOTTIC AIRWAY USE IN PEDIATRICS

Historically, SGAs were used mostly to replace the face mask with spontaneous ventilation in the operating room; however, now they are often used to deliver positive pressure ventilation and are even used in many clinical scenarios where tracheal intubations were typically performed.[1] Supraglottic airways are also an established tool in emergency pediatric airway management, including use in the difficult airway and for resuscitation.[2,3]

A number of SGAs have been used successfully in the pediatric population—the LMA Classic (Teleflex), LMA Unique (Teleflex), and LMA ProSeal (Teleflex) and newer pediatric SGAs such as the air-Q, LMA Supreme (Teleflex), and i-gel. See Table 1 comparing the advantages and disadvantages of these SGAs.

Basic SGA Insertion Techniques

There are 2 approaches to inserting an SGA in children, midline and rotational insertion techniques.

Midline approach (see Figure 1)

1. Position the patient, so the neck is slightly flexed, and the head is extended (maintain neutral neck position if unstable cervical spine).
2. Partially inflate the cuff before insertion to allow it to mold to the shape of the pharynx.
3. Insert the mask with the leading edge against the hard palate.