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Effectiveness of Supraglottic Devices for Airway Management in Emergency Medicine: A Systematic Review of Randomized Control Trials

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Abstract

Objectives: To evaluate the effectiveness of Supraglottic devices (SGAs) compared to other airway management methods. **Methods:** A detailed computerized search of relevant databases was conducted to identify studies that met the inclusion criteria. The search encompassed PubMed, SCOPUS, Science Direct, Cochrane Library, and Web of Science to find pertinent research. **Results:** Our analysis included six studies with a total of 13,681 patients: 7106 in the SAG group and 6682 in the comparison group. Females comprised less than half of the participants, totaling 5853 (42.8%). Clinical parameters were better in the SAG group, the success rate ranged from 68% to 100%, while ranged from 55.9% to 96% in the EI group. EI also recorded higher complication rates of 7.2% than the SAG group 1.7%. Regarding time to successful placement, SAG took less time than EI for example 8.5 seconds compared to 24.5 seconds. The results indicate that SGAs generally outperform EI in terms of first-pass success and overall airway placement time. **Conclusion:** This systematic review highlights the potential advantages of SGAs over EI, particularly in terms of first-pass success and reduced airway placement time, which can be crucial during resuscitation. While SGAs have demonstrated promising results, especially in improving short-term outcomes, further randomized controlled trials are needed to evaluate their long-term effectiveness and safety compared to EI.

Keywords: Supraglottic devices; Airway management; Cardiopulmonary resuscitation; Emergency medicine; Systematic review.

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Introduction

SGAs are commonly utilized in airway control [1]. Children who have surgery benefit the most from the use of SAGs. A variety of SGAs are utilized in children to treat problematic airways and to serve as a conduit for tracheal intubation [2]. The benefits of endotracheal intubation using SAGs, including ease of insertion, improved glottic opening alignment, and continuous patient oxygenation and ventilation, have been extensively demonstrated. Furthermore, SAGs provide a lower hemodynamic stress response to intubation than conventional approaches [3].

Such devices may be an excellent option for individuals who have a history of difficult intubation, limited neck movement, or an unstable cervical spine [4]. Furthermore, SAGs help to overcome upper airway blockage and provide hands-free airway support via a very simple approach to the larynx [5]. However, despite this data, selecting the best SAG is not an easy option.

In recent years, considerable debate has emerged over which airway device (tracheal tube [TT], SGA, or face mask [FM]) is the quickest for securing the airway and ensuring effective ventilation without disrupting chest compression maneuvers, thereby enhancing patient outcomes [6]. Tracheal intubation (TI) has traditionally been the standard approach for pre-hospital airway management since paramedic services were established. However, much of the existing evidence on airway management and ventilation during cardiopulmonary resuscitation (CPR) comes from studies in anaesthesia, mannequin simulations, or observational research, rather than from randomized controlled trials involving patients undergoing CPR [7]. Furthermore, several studies have reported a concerning incidence of undetected esophageal intubation [8, 9].

Airway management is a critical component in emergency medicine, particularly during resuscitation efforts in patients experiencing respiratory or cardiac arrest. The traditional use of tracheal intubation has been the gold standard for securing the airway in pre-hospital and hospital settings. However, it is often associated with challenges, including the risk of unrecognized esophageal intubation and interruptions in chest compressions. In recent years, SGAs have gained attention as alternative tools for airway management due to their ease of insertion and potential to reduce complications. Despite their increasing use, the comparative effectiveness of SGAs versus other airway devices like tracheal tubes or face masks in emergency situations remains unclear. Therefore, a systematic review of randomized controlled trials (RCTs) is necessary to evaluate the effectiveness and safety of SGAs in airway management in emergency medicine.

The objective of this systematic review is to evaluate the effectiveness of SGAs compared to other airway management methods, such as tracheal intubation and face masks, in emergency medicine settings. This review aims to assess the ability of SGAs to secure the airway, provide adequate ventilation, minimize complications, and improve patient outcomes during emergency interventions based on evidence from randomized controlled trials.

Methods

This study conducted a systematic review following the guidelines set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10]. We performed an electronic search on the effectiveness of SGAs compared to other airway management methods in emergency medicine. The search encompassed databases such as PubMed, Web of Science, SCOPUS, and Science Direct. Our search strategy included keywords related to SGA and emergency incidnts. Independently analyzing the search results, two reviewers chose eligible studies, retrieved data, and used appropriate assessment instruments to gauge the caliber of the included study.

Eligibility Criteria

Inclusion Criteria:

1. Population: Adult patients (≥18 years) in the emergency department.
2. Intervention: Studies that assess outcomes of SGA used in emergency incidents for airway resuscitation.
3. Outcomes: Studies reporting on clinical outcomes, including but not limited to success rates, time to successful placement, and complication rates.
4. Study Design: only RCTs.
5. Language: English-language articles published.
6. Time Frame: Articles published within the last 10 years, or a specified relevant time frame defined by the researchers.

Exclusion Criteria:

1. Population: Studies involving pediatric patients (<18 years) or patients undergoing elective surgeries.
2. Intervention: Studies that do not clearly compare an SGA to another method such as ET.
3. Outcomes: Studies that do not report relevant outcomes.
4. Study Design: any study design other than RCT.
5. Language: Studies not published in English.
6. Duplicated Data: Studies that have overlapping patient populations or outcomes reported in other included studies.

Data Extraction

Rayyan (QCRI) was utilized to verify the accuracy of the search results [11]. The search produced titles and abstracts, which were assessed for relevance based on the established inclusion and exclusion criteria. The research team meticulously reviewed all studies meeting these criteria. Any disagreements were resolved through discussion and consensus. Key study data were systematically recorded using a predefined extraction form, including titles, authors, publication year, study location, participant demographics, gender distribution, type of used device, comparison group, first-pass success rate, time to successful placement in minutes, complication rate, and main outcomes. An unbiased evaluation tool was created to assess the potential for bias in the included studies.

Data Synthesis Strategy

Summary tables were developed using information from relevant studies to provide a qualitative overview of the research findings and key elements. After completing data collection for the systematic review, the most effective method for utilizing the information from the included studies was determined.

Results

Systematic search outcomes

A thorough search of 624 study papers yielded 289 duplicates that were disregarded. After reviewing the titles and abstracts of 335 studies, 288 articles were rejected. Out of the 47 reports that were necessary, 1 was not found. 25 papers were excluded because the study results were inaccurate, one was editor's letters, and three were abstracts. 11 of the 46 publications that passed the full-text screening stage were disqualified for using the wrong demographic types. The qualifying requirements are met by the six research publications that comprise this systematic review. A diagram illustrates the process by which the literature was selected in **Figure 1.**

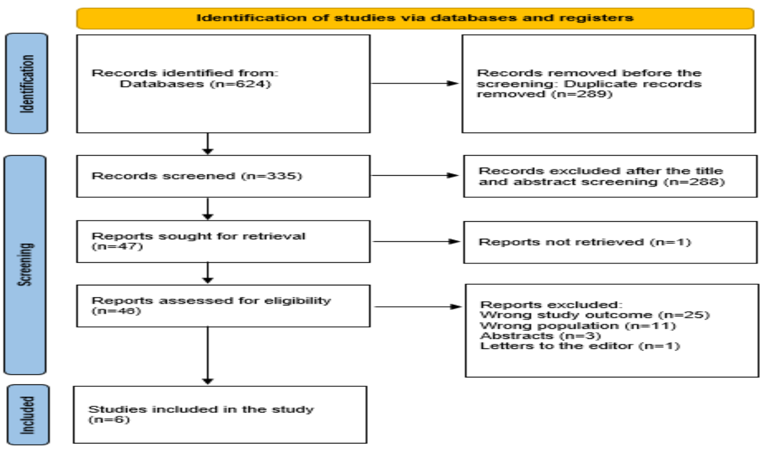

Figure 1: A PRISMA diagram is employed to encapsulate the research decisions.

Sociodemographics and clinical parameters of the involved participants and studies

Table 1 summarizes the socio-demographic data from the research articles. Our analysis included six studies with a total of 13,681 patients: 7106 in the SAG group and 6682 in the comparison group. Females comprised less than half of the participants, totaling 5853 (42.8%). All of the comprised studies were RCTs [13-18]. Geographically, two studies were conducted in the USA [13, 16], two in Poland [15, 17], and one each in the UK [14] and Taiwan [14]. The earliest study was conducted in 2017 [17] and the latest in 2024 [13].

Table (2) shows the clinical parameters

Clinical parameters were better in the SAG group, the success rate ranged from 68% [13] to 100% [17], while ranged from 55.9% [16] to 96% [13] in the EI group. EI also recorded higher complication rates of 7.2% [13] than the SAG group 1.7% [13]. Regarding time to successful placement, SAG took less time than EI for example 8.5 seconds compared to 24.5 seconds [15].

The results indicate that SGAs generally outperform EI in terms of first-pass success and overall airway placement time. This suggests that SGAs may reduce the risk of respiratory infections due to quicker insertion times. In contrast, some studies found no significant differences between ETI and i-gel groups after three and six months.

SGA have proven to be strong alternatives, particularly when compared to blind intubation, which remains an effective airway management method. One study highlighted that using an initial LT insertion strategy led to significantly higher 72-hour survival rates compared to EI. Moreover, blind intubation with i-gel devices outperformed EI in terms of success rate and time required for definite tube installation when using Macintosh laryngoscopes.

Table (1): Sociodemographic parameters of the comprised research.

Study ID	Study design	Country	Participants (n)	Mean age	Females (%)
Levi et al., 2024 [13]	RCT	USA	199	64-76	92 (46.2%)
Benger et al., 2020 [14]	RCT	UK	9289	NM	4100 (44.1%)
Poland et al., 2018 [15]	RCT	Poland	161	35	79 (59%)
Wang et al., 2018 [16]	RCT	USA	3,004	NM	1175 (39.1%)
Gawlowski et al., 2017 [17]	RCT	Poland	92	31.5 ± 6.5	40 (43.5%)
Lee et al., 2022 [18]	RCT	Taiwan	936	73.3 ± 28.3	367 (39.2%)

Table (1): Clinical parameters and outcomes of the comprised research.

	SGA group					Comparison group					

Study ID	Device	n	First-pass success	Time to be placed	Complications	Comparison	n	First-pass success	Time to be placed	Complications	Main outcomes
Levi et al., 2024 [13]	SGA (i-gel)	116	56 (68%)	6 m	2 (1.7%)	EI	83	111 (96%)	9.6 m	6 (7.2%)	The SGA outperformed the ETI in terms of first-pass airway device insertion success and overall airway placement time, potentially minimizing exposure to respiratory infections.
Benger et al., 2020 [14]	SGA (i-gel)	4886	NR	NR	NR	EI	4410	NR	NR	NR	There were no significant changes between the TI and i-gel groups after three and six months.
Poland et al., 2018 [15]	SGA (i-gel)	134	109 (81.3%)	8.5 s	NR	EI	127	96 (71.7%)	24.5 s	NR	SGA are solid alternatives, and blind intubation with them is an effective airway management method.
Wang et al., 2018 [16]	LT insertion	1505	1194 (88.2%)	NR	159 (10.6%)	EI	1499	726 (55.9%)	NR	154 (10.3%)	When compared to an initial ETI method, an initial LT insertion strategy resulted in considerably higher 72-hour survival.
Gawlow	SGA (i-	46	46 (100	11.	NR	EI	46	39 (84.	20 s	NR	Blind intubation with the iGEL SGA outperformed ETI with the Macintosh laryngoscope done by paramedics in

ski et al., 2017 [17]	gel)		%)	5 s				8%)			terms of success rate and time to definite tube installation.
Lee et al., 2022 [18]	SGA (i-gel)	419	360 (83%)	7 m	NR	EI	517	413 (77%)	7 m	NR	Initial airway treatment with ETI did not result in a better outcome of sustained R OSC than insertion of an SGA device.

NR=Not-reported

EI=Endotracheal intubation, LT= laryngeal tube

Discussion

The results in this review indicate that SGAs generally outperform EI in terms of first-pass success and overall airway placement time. This suggests that SGAs may reduce the risk of respiratory infections due to quicker insertion times. In contrast, some studies found no significant differences between ETI and i-gel groups after three and six months. SGAs have proven to be strong alternatives, particularly when compared to blind intubation, which remains an effective airway management method.

We found that clinical parameters were better in the SAG group, the success rate ranged from 68% [13] to 100% [17], while ranged from 55.9% [16] to 96% [13] in the EI group. EI also recorded higher complication rates of 7.2% [13] than the SAG group 1.7% [13]. Regarding time to successful placement, SAG took less time than EI for example 8.5 seconds compared to 24.5 seconds [15]. Similarly, **Borges *et al.*** reported that SGAs are thought to be faster to use than orotracheal intubation, resulting in less time spent on ventilatory support procedures due to the heterogeneity discovered. Subgroup analysis revealed that healthcare providers working in emergency and surgery situations performed similarly [19]. Another literature review by **Hendinezhad *et al.*** also found that because of its distinguishing properties, i-gel may be the ideal SGA for youngsters [20].

Five of the six studies in this review used i-gel. The I-gel is made of a medical-grade thermoplastic elastomer with a flexible, gel-like cuff that forms an anatomical impression around the laryngeal entrance. This design is intended to create a non-inflatable anatomical seal while minimizing compression stress. It has both an airway tube and a stomach drain tube [21, 22]. Investigations have shown that I-gel's insertion time is reduced, leading to a lower frequency of sore throat [23], although its success rate and complications are comparable to other SAGs [24]. Because of the firmness and natural or pharyngeal curve of the tube section, the device can be inserted into the pharynx by grasping the proximal end against the hard palate without inserting the fingers into the patients' mouths [23].

SAGs serve several functions in airway management, including a channel for intubation, a means of transition for extubation, an evacuation mechanism in pre- and in-hospital locations a definitive tool in emergency anesthesia, and an appropriate choice for patients receiving unplanned or mechanical ventilation [25].

SAGs have been shown to have advantages over ETTs, including ease of insertion, the absence of neuromuscular blocking medications, improved spontaneous respiration, and the avoidance of translaryngeal location, which is associated with cardiovascular consequences and near vocal cord contact.

A meta-analysis found that there was less laryngospasm and fewer cases of postoperative hoarse voice, coughing, and painful throat [26, 27].

Emergency airway management is critical in the intensive care unit (ICU), where patients are critically ill and have few physiological reserves, as well as in other hospital settings that frequently lack advanced technology and personnel [28]. In prehospital airway management, SAGs can be used in conjunction with or instead of mask or ETT implantation. **Lee *et al.*** contrasted the benefits of prehospital sophisticated airway management for individuals with out-of-hospital cardiac arrest (OHCA) using ETT or SAG and discovered that SAG could be comparable to ETT in terms of metrics such as ventilation achievement and return of spontaneous circulation and that the two could be used interchangeably [29]. Furthermore, the initial LT insertion technique was linked to significantly improved 72-hour survival in adults diagnosed with OHCA [30]. However, randomly assigning to a previous airway management approach employing SAG did not result in better functional outcomes at 30 days than ETT [31].

The findings suggest that SGAs may offer a quicker and equally effective alternative to EI in emergency airway management, particularly in cases where rapid airway access is critical. With a higher first-pass success rate and shorter placement time, SGAs could reduce the risk of complications associated with delayed airway management, such as respiratory infections. These devices can be particularly useful in pre-hospital or resource-limited settings where EI may not be feasible or where skilled personnel are unavailable. However, clinicians should still consider the individual patient's condition, as well as the context, to determine the most appropriate airway management strategy.

Limitations

Several limitations should be acknowledged based on the findings. First, there was variability in study designs and methodologies, which could impact the comparability of results across trials. Additionally, many studies did not report key parameters such as the time to place the airway devices or the complications associated with their use. The absence of long-term outcome data in some cases limits the ability to assess the sustained effectiveness of SGAs compared to EI. Finally, the reliance on observational data and the lack of randomized controlled trials in some instances may affect the strength of the conclusions drawn.

Conclusion

This systematic review highlights the potential advantages of SGAs over EI, particularly in terms of first-pass success and reduced airway placement time, which can be crucial during resuscitation. While SGAs have demonstrated promising results, especially in improving short-term outcomes, further randomized controlled trials are needed to evaluate their long-term effectiveness and safety compared to EI. In the meantime, SGAs represent a viable and efficient alternative in emergency airway management, particularly in situations where rapid airway control is essential.

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