Received: 29 August 2023 | Revised: 4 March 2024 | Accepted: 7 March 2024

DOI: 10.1002/emp2.13150

JACEP OPEN
JOURNAL OF THE AMERICAN COLLEGE OF EMERGENCY PHYSICIANS OPEN
A GLOBAL JOURNAL OF EMERGENCY MEDICINE
WILEY

ORIGINAL RESEARCH

Airway

The i-gel® supraglottic airway device compared to endotracheal intubation as the initial prehospital advanced airway device: A natural experiment during the COVID-19 pandemic

Daniel Levi MD[1] | Joris Hoogendoorn MD[1] | Shenae Samuels PhD[1] | Lindsay Maguire MD[2] | Ruben Troncoso EMT-P[3] | Scott Gunn EMT-P[3] | Matthew Katz[4] | Christine VanDillen MD[2] | Susan A. Miller MD[2] | Jay L. Falk MD[2] | Steven H. Katz MD[1] | Linda Papa MD, MSc[2]

[1]Department of Emergency Medicine, Memorial Hospital West, Pembroke Pines, Florida, USA

[2]Department of Emergency Medicine, Orlando Health Orlando Regional Medical Center, Orlando, Florida, USA

[3]Pembroke Pines Fire Rescue Department, Pembroke Pines, Florida, USA

[4]Florida Atlantic University, Boca Raton, Florida, USA

Correspondence
Linda Papa, Department of Emergency Medicine, Orlando Health Orlando Regional Medical Center, 86 W. Underwood (S-200), Orlando, FL 32806, USA.
Email: lpstat@aol.com

Steven H. Katz and Linda Papa are senior authors.

Abstract

Objective: Unlike randomized controlled trials, practical real-world studies can offer important information about implementation of prehospital interventions, particularly in community settings where there may be reluctance to adopt new practices. We present the results of a natural experiment that was driven by mandated COVID-19 pandemic-driven shift from endotracheal intubation (ETI) to the i-gel® supraglottic airway (SGA) as a primary advanced airway management device in the prehospital setting to reduce emergency medical services (EMS) personnel exposure to potentially infectious secretions. The objective was to compare first-pass success and timing to successful airway placement between ETI and the i-gel® SGA under extenuating circumstances.

Methods: This pre/post study compared airway placement metrics in prehospital patients requiring advance airway management for non-trauma-related conditions. Data from EMS records were extracted over 2 years, 12 months pre-pandemic, and 12 months post-pandemic. During the pre-COVID-19 year, the EMS protocols utilized ETI as the primary advanced airway device (ETI group). Post-pandemic paramedics were mandated to utilize i-gel® SGA as the primary advanced airway device to reduce exposure to secretions (SGA group).

Results: There were 199 adult patients, 83 (42%) in the ETI group and 116 (58%) in the SGA group. First-pass success was significantly higher with SGA 96% (92%–99%) than ETI 68% (57%–78%) with paramedics citing the inability to visualize the airway

Supervising editor: Nicholas Johnson, MD

in 52% of ETI cases. Time to first-pass success was significantly shorter in the SGA group (5.9 min [5.1–6.7 min]) than in the ETI group (8.3 min [6.9–9.6 min]), as was time to overall successful placement at 6.0 min (5.1–6.8 min) versus 9.6 min (8.2–11.1 min), respectively. Multiple placement attempts were required in 26% of ETI cases and 1% of the SGA cases. There were no statistically significant differences in the number and types of complications between the cohorts. Return of spontaneous circulation (on/before emergency department [ED] arrival), mortality at 28 days, intensive care unit length of stay, or ventilator-free days between the groups were not statistically different between the groups.

Conclusion: In this natural experiment, the SGA performed significantly better than ETI in first-pass airway device placement success and was significantly faster in achieving first-pass success, and overall airway placement, thus potentially reducing exposure to respiratory pathogens. Practical real-world studies can offer important information about implementation of prehospital interventions, particularly in community settings and in systems with a low frequency of tracheal intubations.

KEYWORDS
airway, COVID-19, emergency medical services, endotracheal intubation, ICU length of stay, mortality, out-of-hospital cardiac arrest, pandemic, paramedics, prehospital, return of spontaneous circulation, supraglottic airway, ventilator-free days

1 | BACKGROUND

Endotracheal intubation (ETI) is generally regarded as the gold standard technique for airway management, whether in- or out-of-hospital and is a critical skill for prehospital responder.[1,2] Challenges that arise from inadequate conditions for airway management in the prehospital setting include poor positioning, lack of scene safety, lack of suction or adjunct airway devices, and, depending on agency protocols, inability to adequately sedate or paralyze patients who require airway management.[3–6] Moreover, many prehospital agencies do not have the case volumes or acuity necessary to keep skills tuned, which would require 200–250 ETIs per year to remain proficient at intubating.[5]

There were several disruptions to the prehospital management of out-of-hospital cardiac arrest (OHCA) patients during the COVID-19 pandemic, as evidenced by reduced bystander cardiopulmonary resuscitation (CPR) and automated external defibrillator use, longer times to ambulance arrival, fewer ETIs, and increased supraglottic airway (SGA) placement by paramedics.[7] There was a 120% increase in OHCA within the first year of the pandemic as well as significantly higher mortality with fewer patients surviving to hospital admission and discharge.[7]

1.1 | Importance

Prior to the COVID-19 pandemic, optimal prehospital airway management was already a controversial topic with studies comparing ETI versus bag–valve–mask versus SGA yielding mixed results.[2] There is evidence to suggest that prehospital ETI as opposed to less invasive techniques may cause harm, especially in the case of unrecognized misplaced ETI[8,9] as well as being associated with multiple and prolonged CPR interruptions.[10,11] There is a growing body of evidence to suggest that SGA placement is non-inferior to ETI in the prehospital setting as first-line airway management for non-traumatic respiratory failure or cardiac arrest.[12–15] A second-generation SGA, the i-gel®, has been proven to be simple and effective in the prehospital setting.[16–19] In the AIRWAYS-2 trial, 9296 patients with OHCA were randomized to either i-gel® SGA or ETI and favorable neurologic outcome at 30 days was no different between the two techniques.[12] These data suggest that the i-gel® SGA is, at minimum, non-inferior to ETI in prehospital airway management.

1.2 | Goals of this investigation

During the COVID-19 pandemic, emergency medical service (EMS) agencies across the world adjusted their protocols not only to improve treatment of suspected COVID-19 patients, but also to protect prehospital practitioners from exposure to respiratory pathogens. Research to define optimal processes of prehospital care for optimizing rescuer safety and patient outcome during a pandemic is critically needed. Unlike randomized controlled trials, practical real-world studies can offer important information about implementation of prehospital interventions, particularly in community settings, where there may be reluctance to adopt new practices. We present the results of a natural experiment that was driven by mandated COVID-19 pandemic-driven shift from ETI to the i-gel® SGA as a primary advanced airway man-

The Bottom Line

The optimal approach to airway management in the prehospital setting is not known, and probably varies based on patient, healthcare professional, and system factors. In this, before-and after-study spanning- the COVID-19 pandemic where first-line airway management strategy changed from tracheal intubation to supraglottic device, supraglottic devices were associated with several favorable process measures, including higher first-pass placement success, higher overall success, and faster placement. Notably, this study was conducted in a prehospital system with relatively low frequency of airway management events. While further studies are needed to define best practices for prehospital airway management, this study aligns with other literature supporting the use of supraglottic devices for airway management in the prehospital setting.

agement device in the prehospital setting to reduce EMS personnel exposure to potentially infectious secretions. This study sought to evaluate whether the i-gel® SGA was an appropriately safe and effective alternative to ETI as first-line intervention for patients requiring an advanced airway in the prehospital setting by comparing first-pass success and timing to successful airway placement between ETI and the i-gel® SGA under extenuating circumstances.

2 | METHODS

2.1 | Study design and setting

This quasi-experimental pre/post study evaluated patients requiring advanced airway management in the prehospital setting at a single large community advanced life support fire rescue agency composed of 220 paramedics and EMTs, serving over 170,000 residents in southern Broward County in the Lauderdale/Miami metropolitan area in South Florida. The agency responds to over 17,600 calls per year and performs an average of 105 (<1%) prehospital ETIs per year, mostly for OHCA and respiratory arrest. The agency conducts scheduled intubation training at least two times a year with impromptu training and skill checks multiple times throughout the year. Prehospital patient encounters were extracted from the (ESO®). electronic health record of this fire rescue agency over 2 years pre- and post-pandemic. In pre-COVID-19 period, between March 26, 2019, and March 25, 2020, the prehospital protocols utilized ETI as the primary advanced airway device (ETI group). There was no use of SGA as a primary airway during this period. In post-COVID-19 period, between March 26, 2020, and March 26, 2021, paramedics were mandated to use the i-gel® SGA as the primary advanced airway device to reduce exposure to secretions (SGA group) to protect responders from possible exposure to COVID-19 from direct laryngoscopy. There was no use of ETI as a primary airway during this period.

These were mandated protocols that specified ETI as the primary advanced airway device in the pre-pandemic period (prior to COVID) and then mandated SGA as the primary advanced airway device post-pandemic.

The i-gel® is a second-generation SGA device with a soft non-inflatable cuff. The rim of the mask conforms to the anatomical shape of the larynx and provides an airtight seal without the cuff mechanism. It has an integrated bite block and a gastric channel drain tube. The agency selected this particular SGA device because it was rated for its ease of use, time of insertion, and minimal steps to complete the intervention. There was no financial incentive for selecting this device.

2.2 | Population

The inclusion criteria were (1) age 18 years or older, (2) non-traumatic OHCA/respiratory arrest or need for airway support, and (3) treated by a paramedic. Exclusion criteria were resuscitation deemed inappropriate or advanced airway already in place. Ethics approval was obtained from the Memorial Healthcare System Institutional Review Board.

2.3 | Procedures

After specific training in the research aims, objectives, and data variables, data were extracted using a standard data abstraction form by two emergency medicine resident physicians and entered into a Research Electronic Data Capture (REDCap) tool, hosted at Memorial Healthcare System, for data extraction and analysis. REDCap is a secure and Health Insurance Portability and Accountability Act compliant web-based database, which is used to support clinical and research studies. If there was a case in which there was uncertainty or dispute, the investigators discussed that case in order to make a joint decision. Extracted data included age, sex, airway device, first-pass success, time to intubation, number of intubation attempts, reason for intubation, reason for first-pass failure, and complications. The data extraction form was based on the Utstein reporting guidelines for prehospital advanced airway management.[20] Additional data were obtained from the hospital record and included 28-day mortality, ventilator-free days, and intensive care unit (ICU) length of stay. Missing data were not imputed.

2.4 | Outcome measures

The primary outcome measure was first-pass airway device placement success as defined by first attempt to place an endotracheal tube or SGA device with the presence of end-tidal carbon dioxide continuous waveform capnography with normal-appearing ETCO2 waveform over two to four breathing cycles, bilateral breath sounds, and ability to ventilate with chest rise and fall. For ETI specifically, an intubation attempt

was defined as the placement of a laryngoscope blade into the pharynx with the aim of exposing the glottis, and intubation success was defined as placement of the distal end of the endotracheal tube and cuff into the patient's trachea with confirmation of end-tidal carbon dioxide continuous waveform capnography,[21] which was read and measured via the Lifepak15 (Stryker®), bilateral breath sounds, and ability to ventilate. Video laryngoscopy was not used and neuromuscular blockade was not part of the prehospital protocol for cardiac arrest intubations. Similarly, intubation attempt for the SGA was defined as the placement of the device into the airway and intubation success defined as presence of end-tidal carbon dioxide continuous waveform capnography, bilateral breath sounds, and ability to ventilate.

Secondary measures included time to first attempt that was successful (minutes), time to successful airway placement (minutes), number of placement attempts, and placement complications. During the COVID-19, it was imperative for the safety of rescuers to minimize the time of contact with a patient's airway and airway secretions in order to reduce exposure to respiratory pathogens. Time to first-pass success (minutes) was measured by subtracting "time of arrival on scene" from "time of successful airway device placement." Timing of first-pass success was considered an important metric in potentially reducing exposure to infectious secretions. Time to first attempt (minutes) was measured by subtracting "time of arrival on scene" from "time of first attempt." Time to first-pass success and time of first attempt were called out by the paramedic on the scene and/or recorded from the LifePak15 (Stryker®) and transcribed into an electronic data system.

Recorded complications included aspiration, incorrect placement of airway device, hypotension, and hypoxia. Tertiary outcomes included return of spontaneous circulation (ROSC), 28-day mortality, ventilator-free days, and length of ICU stay. Ventilator-free days were calculated as "0" if the patient died within 28 days of mechanical ventilation or remained ventilated for over 28 days. Ventilator-free days were calculated as "28 – *X*" if a patient was successfully liberated from mechanical ventilation *X* days from initiation.[22]

3 | ANALYSIS

Descriptive statistics were reported using mean and medians with 95% confidence intervals (CIs) and interquartile ranges for continuous variables. Frequencies and proportions with 95% CIs were used for categorical variables. Pearson's Chi-square test was used to compare categorical variables or, where appropriate, Fisher's exact test. Independent sample *t*-test and Mann–Whitney *U*-test were used to assess continuous variables. Results were statistically significant at $p < 0.05$. Analyses were performed using SPSS 29.0 (IBM Corporation®).

4 | RESULTS

There were 199 adult patients included in the analysis, 83 (42%) in the ETI group and 116 (58%) in the SGA group. Mean age was 70 years and there were 46% female/54% male with no statistically significant differences between the airway groups (Table 1). There was a similar proportion of cardiac arrest patients in each group; 93% versus 92% in the ETI and SGA groups, respectively. There were significantly more witnessed arrests in the ETI versus SGA group (49% vs 25%, respectively) as well as more bystander CPR (22% vs 12%, respectively). Overall, prehospital times were similar between the groups with no significant differences in time from 911 call to scene, or transport times from scene to hospital. However, time on scene was significantly shorter in the SGA group by 2 min ($p = 0.008$).

First-pass success was significantly higher in the SGA group at 96% (95% CI 92–99) compared to the ETI group at 68% (95% CI 57–78). Paramedics cited that they were unable to visualize the airway in 52% of ETI cases (Table 2). Time to first-pass success was significantly shorter in the SGA group at 5.9 min (95% CI 5.1–6.7) than for ETI at 8.3 min (95% CI 6.9–9.6). Time to overall successful placement was also significantly shorter in the SGA group at 6.0 min (95% CI 5.1–6.8) than for ETI group at 9.6 min (95% CI 8.2–11.1). There were also significantly more placement attempts with ETI than SGA at an average of 1.3 (95% CI 1.2–1.4) versus 1.0 (95% CI 0.99–1.03) attempts, respectively (Table 2). Multiple placement attempts were required in 26% of ETI cases compared to only 1% of the SGA cases.

There were no statistically significant differences in the number and types of complications between the two cohorts (Table 3). In the assessment of ROSC in the cardiac arrest cohort, a higher proportion of patients in the SGA cohort achieved ROSC prior to or after emergency department (ED) arrival (37%) than the ETI cohort (27%), but the difference was not statistically significant (Table 3). Mortality at 28 days was not statistically significant between the two groups with 11% versus 14% in the ETI versus SGA groups. There were also no significant differences in ICU length of stay or ventilator-free days between the groups (Table 3).

5 | LIMITATIONS

There are several limitations to this study. This was a retrospective analysis of a natural experiment that occurred before and during the COVID-19 pandemic as prehospital protocols were adjusted for the safety of responders. It did not meet the rigor of a randomized controlled trial and is underpowered to make definitive conclusions. Because of the nature of the COVID-19 pandemic, there may be inherent differences in pathology of the treatment groups that were not controlled for the purposes of this study. These differences may have impacted outcomes in the patients included. With high mortality rates in patients with COVID-19 in the early phases of the pandemic, this could have led to increased mortality in the post-COVID-19 group. In addition, trauma patients were not included in this study and as such more data would be required to evaluate appropriateness of SGA use in trauma patients. Paramedics were not blinded to the intervention and therefore may have exhibited more skill or preference for one airway management device over another. The sample size is relatively small and the interventions were not randomized; therefore, defintive conclusions about effectiveness of either airway device cannot be made.

TABLE 1 Patient characteristics.

Characteristics	ETI group (pre-pandemic), $N = 83$	SGA (i-gel) group (post-pandemic), $N = 116$	*p*-Value
Age (mean in years) (95% CI)	73 (70–76)	68 (64–71)	0.034
Female sex, *n* (%)	38 (46%)	54 (47%)	0.999
Primary reason for intubation, *n* (%)			0.529
Cardiac arrest[a]	77 (93%)	107 (92%)	
Respiratory failure	4 (5%)	6 (5%)	
Airway protection	0 (0)	2 (2%)	
Other	2 (2%)	1 (1%)	
Witnessed arrest, *n* (%)			<0.001
Witnessed	41 (49%)	29 (25%)	
Not witnessed	36 (43%)	11 (10%)	
Unknown	6 (7%)	76 (66%)	
Bystander chest compressions/CPR, *n* (%)			<0.001
Yes	18 (22%)	14 (12%)	
No	59 (71%)	26 (22%)	
Unknown	6 (7%)	76 (66%)	
Estimated time from collapse to CPR (min) (available in each group, $n = 58$ and 80)	10 (7–13)	8 (7–10)	0.309
Chest compressions/CPR initiated by, *n* (%)			0.232
Family/lay person	7 (8%)	19 (16%)	
First responder/law enforcement	22 (27%)	32 (28%)	
EMS	48 (58%)	53 (46%)	
Unknown	6 (7%)	12 (10%)	
First electrocardiogram rhythm showing shockable rhythm, *n* (%) (ventricular fibrillation, ventricular tachycardia, AED shockable rhythm)	19 (23%)	15 (13%)	0.085
Epinephrine administered before hospital arrival, *n* (%)	75 (90%)	99 (85%)	0.387
Time from 911 call to first arrival of EMS on scene in minutes (95% CI)	8.9 (8.1–9.7)	9.2 (8.6–9.8)	0.549
Time on scene from EMS arrival to departure from scene in minutes (95% CI)	17.2 (16.2–18.2)	15.3 (14.4–16.2)	0.008
EMS transport time from scene to hospital in minutes (95% CI)	6.6 (5.7–7.5)	6.4 (5.7–7.0)	0.738
Total time from 911 call to hospital arrival in minutes (95% CI)	33.7 (32.1–35.3)	31.8 (30.5–33.0)	0.060
Compliance with mandated airway intervention, *n* (%)	83 (100%)	116 (100%)	0.999

Abbreviations: AED, automated external defibrillator; CI, confidence interval; CPR, cardiopulmonary resuscitation; EMS, emergency medical services; ETI, endotracheal intubation; *n*, number; SGA, supraglottic airway.

[a]Includes cardiac arrest and cardiac arrest together with another reason.

TABLE 2 Primary and secondary outcome results for intubation success.

Characteristics	ETI group (pre-pandemic), $N = 83$ (95% CI)	SGA (i-gel) group (post-pandemic), $N = 116$ (95% CI)	*p*-Value
First-pass success, *n* (%) (95% CI)	56 (68%) (57%–78%)	111 (96%) (92%–99%)	<0.001
Time to first attempt in minutes (95% CI) (available in each group, $n = 80$ and 110)	8.3 (6.9–9.6)	5.9 (5.1–6.7)	0.002
Time to successful placement in minutes (95% CI) (available in each group, $n = 74$ and 110)	9.6 (8.2–11.1)	6 (5.1–6.8)	<0.001
Reason for first-pass failure, *n* (%) (available in each group, $n = 27$ and 5)			0.445
Inability to visualize the airway	14 (52%)	1 (20%)	
Inability to open mouth	1 (4%)	0 (0)	
Inability to secure tube	1 (4%)	0 (0)	
Not specified	11 (41%)	4 (80%)	
Second-pass success, *n* (%) (available in each group, $n = 27$ and 5)			0.057
No	4 (15%)	1 (20%)	
Yes	19 (70%)	1 (20%)	
Not specified	4 (15%)	3 (60%)	
Mean number of airway placement attempts (95% CI)	1.3 (1.18–1.40)	1 (0.99–1.03)	<0.001
Total number of airway placement attempts, *n* (%)			<0.001
1	61 (74%)	115 (99%)	
2	20 (24%)	1 (1%)	
3	2 (2%)	0 (0)	
Cricothyroidotomy, *n* (%)	0 (0)	0 (0)	–

Abbreviations: CI, confidence interval; ETI, endotracheal intubation; *n*, number; SGA, supraglottic airway.

TABLE 3 Complications of intubation and tertiary outcome measures.

Characteristics	ETI group (pre-pandemic), $N = 83$ (95% CI)	SGA (i-gel) group (post-pandemic), $N = 116$ (95% CI)	*p*-Value
Any complication, *n* (%)	3 (4%) (0–8)	1 (1%) (0–3)	0.310
Aspiration	0 (0)	1 (1%) (0–3)	0.999
Esophageal intubation	2 (2%) (0–6)	0 (0)	0.173
Hypotension and hypoxia[a]	1 (1%) (0–4)	0 (0)	0.417
Outcome measures			
Return of spontaneous circulation[b] (available in each group $n = 73$ and 111)	21/77 (27%) (17–37)	39/106 (37%) (27–46)	0.203
Mortality at 28 days (available in each group, $n = 73$ and 111)	8/73 (11%) (4–18)	15/111 (14%) (7–20)	0.656
Ventilator-free days (available in each group, $n = 73$ and 111)	1.7 (0.4–3.0)	2.1 (0.9–3.4)	0.665
ICU length of stay (days) (available in each group, $n = 74$ and 111)	2.1 (0.8–3.4)	2.8 (1.6–3.9)	0.469

Abbreviations: CI, confidence interval; ETI, endotracheal intubation; ICU, intensive care unit; *n*, number; SGA, supraglottic airway.
[a]Changes in blood pressure and oxygenation during the procedure.
[b]Before or at emergency department (ED) arrival.

Although first-pass success is an important endopoint, there were no data on neurologically intact outcome. Additionally, there was a significant amount of missing data for mortality, ICU stay, and ventilator-free days, which are important patient outcomes. While there was significant concern of viral transmission during CPR administration, data were not collected on COVID-19 transmission. Limited evidence exists in the literature about the transmission of infection from patient to rescuer.[23,24] Successful first-pass endotracheal tube placement is associated with responder experience and volume of ETIs performed, with success rates in excess of 80% in high-volume EMS systems.[25–27] In this study, the volume of ETIs is relatively low compared to high volume systems, where hundreds of intubations are performed annually. Therefore, the results of this study may not generalize to EMS systems with higher tracheal intubation volumes and where prehospital responders experience a high volume of ETIs.

6 | DISCUSSION

This study was not designed as an efficacy trial but rather a description of a real-life public health crisis that required a shift in prehospital airway management to maintain quality of care while keeping EMS responders safe. In this natural experiment pre/post study, prehospital patients managed with SGA had fewer airway attempts, shorter time to successful placement, and higher first-pass success rates. First-pass success was nearly 30% higher in the SGA group, likely owing to ease of placement. The most cited reason for first-pass failure in the ETI group was inability to visualize the airway. As the SGA does not require airway visualization, these airways likely would have been successfully managed with SGA. Twenty-six percent of patients in the ETI group versus just one patient (<1%) in the SGA group required a second airway attempt, therefore, increasing the mean time to airway securement. Except for tube misplacement, complication rates such as aspiration, hypoxia, and hypotension were low in both groups. All of these findings occurred without any significant differences in patient outcomes includuing mortality, ventilator-free days, or ICU length of stay. Additionally, the length of time EMS was on the scene with the patient was also significantly shorter in the SGA group by 2 min. Inherently, this was a successful prehospital transition from ETI to SGA in the midst of a major pandemic.

In terms of group charachteristics, the patients were similar in the two groups. Where they differed was in the number of arrests that were witnessed and the number of patients that received bystander chest compressions. These favored the ETI group. However, there was a considerable amount or missing data for these parameters in the SGA group, likely due to the nature of the encounters during the post-pandemic period. Despite this, the outcomes in both groups (mortality, ventilator-free days, or ICU length of stay) were similar.

Currently, SGA is used by many in- and out-of-hospital responders as the go-to airway adjunct when ETI is not possible. While it is not considered a definitive airway, our results suggest that SGA placement has few complications and is effective in providing ventilation in the prehospital setting. Additionally, the results are consistent with large-scale studies.[12,13] Unlike randomized controlled trials, practical real-world studies can offer important information about implementation of prehospital interventions particularly in community settings where there may be reluctance to adopt new practices. This study may serve as a catalyst for other agencies to consider assessing SGA device use as a first-line alternative.

There is a growing body of evidence to suggest that SGA placement is non-inferior to ETI in the prehospital setting as first-line airway management for non-traumatic respiratory failure or cardiac arrest.[12,13] SGAs have gained popularity secondary to ease of use, reduced training requirements, minimal risk of misplaced tube, reduced procedure time, and decreased interruptions in CPR.[14,15] In a 3000-patient randomized trial of OHCA comparing ETI to a laryngeal tube (King Laryngeal Tube [King LT]), patients receiving the laryngeal tube had 2.9% lower mortality at 72 h as well as modest yet significant improvements in rates of ROSC, hospital survival, and survival with favorable neurologic outcome as compared to those managed with ETI.[13]

In particular, the second-generation SGA, the i-gel®, has been shown to be simple and effective. Kannaujia et al. in 2009 showed that the success rate at first attempt with the i-gel® was 90%, taking a median time of 11 s to place.[16] In 2013, in one of the first prehospital studies to evaluate the use of the i-gel® supraglottic device, Haske et al. found a 90% first-pass success rate with i-gel® in OHCA.[17] In 2022, Price et al. retrospectively compared i-gel® to the King LT, with a higher (90.6% vs. 76.6%) first-pass success rate.[18] In a randomized controlled prehospital airway trial from Australia, i-gel® was found to have a higher successful insertion rate (90%) in comparison to the first-generation SGAs (57%).[19] In the AIRWAYS-2 trial, 1523 paramedics randomized 9296 patients with OHCA to ETI versus the i-gel® SGA and found no significant differences in favorable functional outcome between ETI (6.8%) and i-gel® (6.4%).[12] These data suggest that the i-gel® SGA is, at minimum, non-inferior to ETI in prehospital airway management.

The simplicity of the i-gel® SGA may allow more time to focus on CPR and other lifesaving treatment modalities. In 2022, NAEMSP published a position statement on OHCA management and stated that airway management should not interfere with other key resuscitation interventions such as high-quality chest compressions, rapid defibrillation, and treatment of reversible causes of the cardiac arrest.[1] Based on results of this and prior studies, the i-gel® SGA is an at least reasonable first-line alternative in the prehospital setting. Given the growing evidence toward a lack of benefit to ETI versus SGA for out-of-hospital airway management and the potential for harm with increased time and resource requirements as well as the potential for missed intubations with ETI, SGA could be considered as a first-line intervention for non-traumatic OHCA and respiratory failure. Although there were no differences in mortality, ventilator-free days, or ICU length of stay, the study is underpowered to make conclusions on these outcomes.

In conclusion, in this natural experiment, the i-gel® SGA performed significantly better than ETI in first-pass airway device placement success and was significantly faster in achieving first-pass success,

and overall airway placement, thus potentially reducing exposure to respiratory pathogens. SGA was successful as a primary advanced airway management device for ventilation during the COVID-19 pandemic in the prehospital environment. Practical real-world studies can offer important information about implementation of prehospital interventions, particularly in community settings and in systems with a low frequency of tracheal intubations.

AUTHOR CONTRIBUTIONS

Steven H. Katz, Shenae Samuels, and Linda Papa had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Steven H. Katz conceived the study. Steven H. Katz and Linda Papa designed the study. Data were acquired by Steven H. Katz, Joris Hoogendoorn, Daniel Levi, Ruben Troncoso, and Scott Gunn. All authors were involved in the analysis and interpretation of the data. Linda Papa, Steven H. Katz, Shenae Samuels, Matthew Katz, Lindsay Maguire, Christine VanDillen, Susan A. Miller, and Jay L. Falk drafted the manuscript, and all authors were involved in critical revision of the manuscript for important intellectual content. Statistical analysis was conducted by Linda Papa and Shenae Samuels. Administrative, technical, or material support was provided by Steven H. Katz, Joris Hoogendoorn, Daniel Levi, Shenae Samuels, Ruben Troncoso, and Scott Gunn.

CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

FUNDING INFORMATION

The authors received no specific funding for this work.

DATA AVAILABILITY STATEMENT

The datasets used and/or analyzed during the current study are not available for sharing at this time but will be available from the corresponding author upon reasonable request in the future.

REFERENCES

1. Carlson JN, Colella MR, Daya MR, et al. Prehospital cardiac arrest airway management: an NAEMSP position statement and resource document. *Prehosp Emerg Care*. 2022;26(1):54-63. doi:10.1080/10903127.2021.1971349
2. Carney N, Totten AM, Cheney T, et al. Prehospital airway management: a systematic review. *Prehosp Emerg Care*. 2022;26(5):716-727. doi:10.1080/10903127.2021.1940400
3. Stewart RD, Paris PM, Winter PM, Pelton GH, Cannon GM. Field endotracheal intubation by paramedical personnel. Success rates and complications. *Chest*. 1984;85(3):341-345. doi:10.1378/chest.85.3.341
4. Pepe PE, Copass MK, Joyce TH. Prehospital endotracheal intubation: rationale for training emergency medical personnel. *Ann Emerg Med*. 1985;14(11):1085-1092. doi:10.1016/s0196-0644(85)80927-6
5. Pepe PE, Roppolo LP, Fowler RL. Prehospital endotracheal intubation: elemental or detrimental? *Crit Care*. 2015;19(1):121. doi:10.1186/s13054-015-0808-x
6. Caruana E, Duchateau FX, Cornaglia C, Devaud ML, Pirracchio R. Tracheal intubation related complications in the prehospital setting. *Emerg Med J*. 2015;32(11):882-887. doi:10.1136/emermed-2013-203372
7. Lim ZJ, Ponnapa Reddy M, Afroz A, Billah B, Shekar K, Subramaniam A. Incidence and outcome of out-of-hospital cardiac arrests in the COVID-19 era: a systematic review and meta-analysis. *Resuscitation*. 2020;157:248-258. doi:10.1016/j.resuscitation.2020.10.025
8. Katz SH, Falk JL. Misplaced endotracheal tubes by paramedics in an urban emergency medical services system. *Ann Emerg Med*. 2001;37(1):32-37. doi:10.1067/mem.2001.112098
9. Silvestri S, Ralls GA, Krauss B, et al. The effectiveness of out-of-hospital use of continuous end-tidal carbon dioxide monitoring on the rate of unrecognized misplaced intubation within a regional emergency medical services system. *Ann Emerg Med*. 2005;45(5):497-503. doi:10.1016/j.annemergmed.2004.09.014
10. Wang HE, Simeone SJ, Weaver MD, Callaway CW. Interruptions in cardiopulmonary resuscitation from paramedic endotracheal intubation. *Ann Emerg Med*. 2009;54(5):645-652.e1. doi:10.1016/j.annemergmed.2009.05.024
11. Christenson J, Andrusiek D, Everson-Stewart S, et al. Chest compression fraction determines survival in patients with out-of-hospital ventricular fibrillation. *Circulation*. 2009;120(13):1241-1247. doi:10.1161/CIRCULATIONAHA.109.852202
12. Benger JR, Kirby K, Black S, et al. Effect of a strategy of a supraglottic airway device vs tracheal intubation during out-of-hospital cardiac arrest on functional outcome: the AIRWAYS-2 randomized clinical trial. *JAMA*. 2018;320(8):779-791. doi:10.1001/jama.2018.11597
13. Wang HE, Schmicker RH, Daya MR, et al. Effect of a strategy of initial laryngeal tube insertion vs endotracheal intubation on 72-hour survival in adults with out-of-hospital cardiac arrest: a randomized clinical trial. *JAMA*. 2018;320(8):769-778. doi:10.1001/jama.2018.7044
14. Gausche-Hill M. Ensuring quality in prehospital airway management. *Curr Opin Anaesthesiol*. 2003;16(2):173-181. doi:10.1097/00001503-200304000-00011
15. Ostermayer DG, Gausche-Hill M. Supraglottic airways: the history and current state of prehospital airway adjuncts. *Prehosp Emerg Care*. 2014;18(1):106-115. doi:10.3109/10903127.2013.825351
16. Kannaujia A, Srivastava U, Saraswat N, Mishra A, Kumar A, Saxena S. A preliminary study of I-gel: a new supraglottic airway device. *Indian J Anaesth*. 2009;53(1):52-56.
17. Haske D, Schempf B, Gaier G, Niederberger C. Performance of the i-gel during pre-hospital cardiopulmonary resuscitation. *Resuscitation*. 2013;84(9):1229-1232. doi:10.1016/j.resuscitation.2013.04.025
18. Price P, Laurie A, Plant E, Chandra K, Pishe T, Brunt K. Comparing the first-pass success rate of the King LTS-D and the i-gel airway devices in out-of-hospital cardiac arrest. *Cureus*. 2022;14(11):e30987. doi:10.7759/cureus.30987
19. Middleton PM, Simpson PM, Thomas RE, Bendall JC. Higher insertion success with the i-gel supraglottic airway in out-of-hospital cardiac arrest: a randomised controlled trial. *Resuscitation*. 2014;85(7):893-897. doi:10.1016/j.resuscitation.2014.02.021
20. Cummins RO, Chamberlain DA, Abramson NS, et al. Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: the Utstein Style. A statement for health professionals from a task force of the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council. *Circulation*. 1991;84(2):960-975. doi:10.1161/01.cir.84.2.960
21. Silvestri S, Ladde JG, Brown JF, et al. Endotracheal tube placement confirmation: 100% sensitivity and specificity with sustained four-phase capnographic waveforms in a cadaveric experimental model. *Resuscitation*. 2017;115:192-198. doi:10.1016/j.resuscitation.2017.01.002
22. Yehya N, Harhay MO, Curley MAQ, Schoenfeld DA, Reeder RW. Reappraisal of ventilator-free days in critical care research. *Am J Respir*

Crit Care Med. 2019;200(7):828-836. doi:10.1164/rccm.201810-2050CP

23. Couper K, Taylor-Phillips S, Grove A, et al. COVID-19 in cardiac arrest and infection risk to rescuers: a systematic review. *Resuscitation*. 2020;151:59-66. doi:10.1016/j.resuscitation.2020.04.022
24. Scquizzato T, Olasveengen TM, Ristagno G, Semeraro F. The other side of novel coronavirus outbreak: fear of performing cardiopulmonary resuscitation. *Resuscitation*. 2020;150:92-93. doi:10.1016/j.resuscitation.2020.03.019
25. Dyson K, Bray J, Smith K, Bernard S, Finn J. A systematic review of the effect of emergency medical service practitioners' experience and exposure to out-of-hospital cardiac arrest on patient survival and procedural performance. *Resuscitation*. 2014;85(9):1134-1141. doi:10.1016/j.resuscitation.2014.05.020
26. Ljungqvist H, Pirneskoski J, Saviluoto A, Setala P, Tommila M, Nurmi J. Intubation first-pass success in a high performing pre-hospital critical care system is not associated with 30-day mortality: a registry study of 4496 intubation attempts. *Scand J Trauma Resusc Emerg Med*. 2022;30(1):61. doi:10.1186/s13049-022-01049-7
27. Dyson K, Bray JE, Smith K, et al. Paramedic intubation experience is associated with successful tube placement but not cardiac arrest survival. *Ann Emerg Med*. 2017;70(3):382-390.e1. doi:10.1016/j.annemergmed.2017.02.002

How to cite this article: Levi D, Hoogendoorn J, Samuels S, et al. The i-gel® supraglottic airway device compared to endotracheal intubation as the initial prehospital advanced airway device: A natural experiment during the COVID-19 pandemic. *JACEP Open*. 2024;5:e13150. https://doi.org/10.1002/emp2.13150

AUTHOR BIOGRAPHY

Daniel Levi, MD, is a resident in the Department of Emergency Medicine at Memorial Healthcare System in Pembroke Pines, Florida.