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REPORTS OF ORIGINAL INVESTIGATIONS

A randomized controlled trial comparing three supraglottic airway devices used as a conduit to facilitate tracheal intubation with flexible bronchoscopy

Une étude randomisée contrôlée comparant trois dispositifs supraglottiques utilisés comme conduit pour faciliter l'intubation trachéale avec un bronchoscope flexible

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Abstract

Purpose *Once difficult ventilation and intubation are declared, guidelines suggest the use of a supraglottic airway (SGA) as a rescue device to ventilate and, if oxygenation is restored, subsequently as an intubation conduit. Nevertheless, few trials have formally studied recent SGA devices in patients. Our objective was to compare the efficacy of three second-generation SGA devices as conduits for bronchoscopy-guided endotracheal intubation.*

Methods *In this prospective, single-blinded three-arm randomized controlled trial, patients with an American Society of Anesthesiologists Physical Status of I–III undergoing general anesthesia were randomized to bronchoscopy-guided endotracheal intubation using AuraGain™, Air-Q® Blocker, or i-gel® devices. We excluded patients with contraindications to an SGA or drugs and who were pregnant or had a neck, spine, or respiratory anomaly. The primary outcome was intubation time, measured from SGA circuit disconnection to CO_2 measurement. Secondary outcomes included ease, time, and success of SGA insertion; success of intubation on first attempt; overall intubation success; number of attempts to intubate; ease of intubation; and ease of SGA removals.*

Results *One hundred and fifty patients were enrolled from March 2017 to January 2018. Median intubation times were similar across the three groups (Air-Q Blocker, 44 sec; AuraGain, 45 sec; i-gel, 36 sec; P = 0.08). The i-gel was faster to insert (i-gel: 10 sec; Air-Q Blocker, 16*

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sec; AuraGain, 16 sec; P < 0.001) and easier to insert (Air-Q Blocker vs i-gel, P = 0.001; AuraGain vs i-gel, P = 0.002). Success of SGA insertion, success of intubation, and number of attempts were similar. The Air-Q Blocker was easier to remove than the i-gel (P < 0.001).

Conclusion *All three second-generation SGA devices performed similarly regarding intubation. Despite minor benefits of the i-gel, clinicians should select their SGA based on clinical experience.*

Study registration *ClinicalTrials.gov (NCT02975466); registered on 29 November 2016.*

Résumé

Objectif *Une fois qu'une ventilation et une intubation difficiles sont déclarées, les lignes directrices préconisent le recours à un dispositif supraglottique comme modalité de sauvetage pour ventiler le patient et, si l'oxygénation est rétablie, être ensuite utilisé comme conduit d'intubation. Toutefois, peu d'études ont formellement analysé l'utilisation des dispositifs supraglottiques récents chez de véritbales patients. Notre objectif était de comparer l'efficacité de trois dispositifs supraglottiques de deuxième génération utilisés comme conduits pour l'intubation endotrachéale guidée par bronchoscopie.*

Méthode *Dans cette étude prospective randomisée contrôlée à trois bras et à simple insu, les patients de statut physique I-III selon l'American Society of Anesthesiologists bénéficiant d'une anesthésie générale ont été randomisés à recevoir une intubation endotrachéale guidée par bronchoscopie via les dispositifs AuraGain™, Air-Q® Blocker ou i-gel®. Nous avons exclu les patients présentant des contre-indications à l'utilisation d'un dispositif supraglottique ou aux médicaments, ainsi que les patientes enceintes et les patients présentant une anomalie au niveau du cou, de la colonne vertébrale ou des voies aériennes. Le critère d'évaluation principal était le temps d'intubation mesuré entre le moment de déconnexion du dispositif supraglottique du circuit et le moment de mesure du CO_2. Les critères d'évaluation secondaires comprenaient la facilité, le délai et la réussite de l'insertion du dispositif supraglottique; la réussite de l'intubation à la première tentative; la réussite globale de l'intubation; le nombre de tentatives d'intubation; la facilité d'intubation; et la facilité de retrait du dispositif supraglottique.*

Résultats *Cent cinquante patients ont été recrutés de mars 2017 à janvier 2018. Les délais d'intubation médians étaient similaires dans les trois groupes (Air-Q Blocker : 44 sec; AuraGain : 45 sec; i-gel : 36 sec; P = 0,08). L'i-gel était plus rapide à insérer (i-gel : 10 sec; Air-Q Blocker : 16 sec; AuraGain : 16 sec; P < 0,001) et plus facile à insérer (Air-Q Blocker vs i-gel : P = 0,001; AuraGain vs i-gel : P = 0,002). La réussite de l'insertion du dispositif supraglottique, la réussite de l'intubation et le nombre de tentatives étaient similaires. L'Air-Q Blocker était plus facile à retirer que l'i-gel (P < 0,001).*

Conclusion *Les trois dispositifs supraglottiques de deuxième génération ont tous affiché une performance similaire en matière d'intubation. Malgré des avantages mineurs de l'i-gel, les cliniciens devraient choisir leur dispositif supraglottique en fonction de leur expérience clinique.*

Enregistrement de l'étude *ClinicalTrials.gov (NCT02975466); enregistrée le 29 novembre 2016.*

Keywords airway · bronchoscope-guided intubation · difficult intubation · endotracheal intubation · intubating laryngeal mask airway · laryngeal masks · supraglottic airway

Supraglottic airway (SGA) devices have a crucial role in airway management when oxygenation of the unconscious patient is compromised. Both the Canadian Airway Focus Group (CAFG) and Difficult Airway Society (DAS) clearly state that, once difficult ventilation and intubation have been declared, an SGA should be quickly tried as a rescue.[1–3] If it is successful in restoring oxygenation, the danger of the situation is drastically reduced and the hands are simultaneously free from mask ventilation, allowing the health care provider to pursue other manipulations. Options can be reassessed for what to do next, as described by the "pause and think" from the CAFG[3] and the "exit strategy" from the DAS.[1] The options include 1) awakening the patient, 2) proceeding with surgery with the SGA, 3) securing the airway with endotracheal intubation, or (rarely) 4) performing a surgical airway. If oxygenation and ventilation are now controlled, the SGA can be used to channel the endotracheal tube (ETT) toward the glottis, especially with bronchoscopic guidance.[4, 5] The SGA will create an intubation conduit by controlling soft tissue collapse and helping indirect visualization of the glottis with the flexible bronchoscope. For these reasons, even in a non-urgent anticipated difficult airway scenario, using an SGA for the purpose of intubation is also a valid approach.

The first SGA purposefully designed as an intubation conduit was the LMA® Fastrach™ (Teleflex Incorporated; Wayne, PA, USA), commercialized in 1997, and recommended as a novel approach to intubate patients with difficult airways.[6] After its insertion, the LMA Fastrach was used to guide the ETT toward the glottis. As the use of flexible bronchoscopes became more widespread, strong literature favored visualization of the

glottis over blind intubation, where no fiber-optic device or cameras are used to witness the ETT insertion in the SGA and the glottis.[7–10] Based on a recent trial, the rate of successful intubation through SGA raised from 76% when blind intubation was attempted to 100% if the glottis was visualized with a bronchoscope (P = 0.03).[8] Intubation time was reduced from 53 to 39 sec (P = 0.001). When the LMA Fastrach was formally compared with the i-gel® (Intersurgical Ltd., Wokingham, Berkshire, UK) in the context of flexible bronchoscope guidance, the success rate was high in both groups, but i-gel allowed shorter intubation times.[7] With different SGA models continuously introduced to market, several randomized controlled trials (RCT) have attempted to identify which SGA leads to the highest success rate for intubation and the quickest manipulations.[11–16] Nevertheless, few trials have formally compared the most recent and popular SGA used in our settings, on real patients and with flexible bronchoscope guidance.

The aim of this superiority RCT was to determine the influence of the SGA devices on the airway management and flexible bronchoscope-guided intubation in adult patients undergoing general anesthesia. Based on the literature, we selected three recent and popular SGA devices: AuraGain™ (Ambu A/S, Ballerup, Denmark), Air-Q® Blocker (Cookgas LLC, Mercury Medical, Clearwater, FL, USA), and i-gel.[17] While the i-gel and the two previous models of the AuraGain (Aura-i™) and Air-Q Blocker (Air-Q) have shown good performance with quick bronchoscope-guided intubation, no trials have directly compared the most recent models in real adult patients. We chose intubation time as primary outcome because it is a good surrogate of both success rate and ease of intubation. Our hypothesis was that i-gel would allow a faster intubation because of the softer angulation than the AuraGain and the fewer required manipulations than the Air-Q Blocker.

Methods

Study design and setting

We conducted a three-arm prospective superiority RCT from March 2017 to January 2018 at the Centre intégré universitaire de santé et de services sociaux de l'Estrie – Centre hospitalier universitaire de Sherbrooke (CIUSSS de l'Estrie-CHUS; Sherbrooke, QC, Canada), an academic center serving 500,000 people. The institutional Research Ethics Board approved the trial before registration (ClinicalTrials.gov: NCT02975466; registered on 29 November 2016) and the research coordinator obtained *a priori* written informed consent from eligible patients.

Participants

Enrolled patients were at least 18 yr old, with an American Society of Anesthesiologists' (ASA) Physical Status of I–III with a planned general anesthesia with endotracheal intubation, for a surgery of at least 30 min duration. Both elective and emergency surgeries were eligible (if conducted during the research hours 8 a.m. to 4 p.m.). We excluded patients with a contraindication to an SGA (defined as uncontrolled gastrointestinal reflux or significant risk of aspiration, oropharyngeal pathology, or overt deformation); with contraindications to the medication administered during anesthesia induction; with severe or uncontrolled obstructive pulmonary disease; with cervical spine anomaly defined by restricted head movement due to pain or neurologic symptoms; and who were pregnant. Because of the limited inclusion criteria, the high number of patients per day in our center, and the limited research resources available to conduct this RCT, it was not possible to recruit all consecutive patients.

Study intervention

Upon entry into the operating room (OR), peripheral intravenous access was established and standard Canadian Anesthesiologists' Society monitoring applied (Fig. 1). A water-soluble lubricant was applied on the posterior side of the SGA before insertion and the ETT was prepared by inserting the bronchoscope (DCI Intubation Scope, 5.2 × 650 mm; KARL STORZ SE & Co. KG, Tuttlingen, Germany) into the lumen of the ETT and by externally applying a water-soluble gel on the distal end of the ETT. After preoxygenation (defined as an end-tidal O_2 concentration over 90%), induction was initiated. Except for rocuronium, the choice of induction medication was left to the discretion of the anesthesiologist. After loss of consciousness, bag-mask ventilation using 100% O_2 was performed until complete paralysis, as confirmed with median nerve stimulation. The final position of the head was determined by the operator and was usually central with a pillow creating the sniffing position recommended for SGA insertion.[18–20] The operator, an attending anesthesiologist or a resident with a least six months of experience in anesthesiology, proceeded to insert the SGA. The attending anesthesiologist selected the size of the SGA but the research assistant encouraged respecting the manufacturer's recommendations. If the size of the first choice of SGA was not appropriate, the protocol allowed the size to be changed to optimize ventilation before

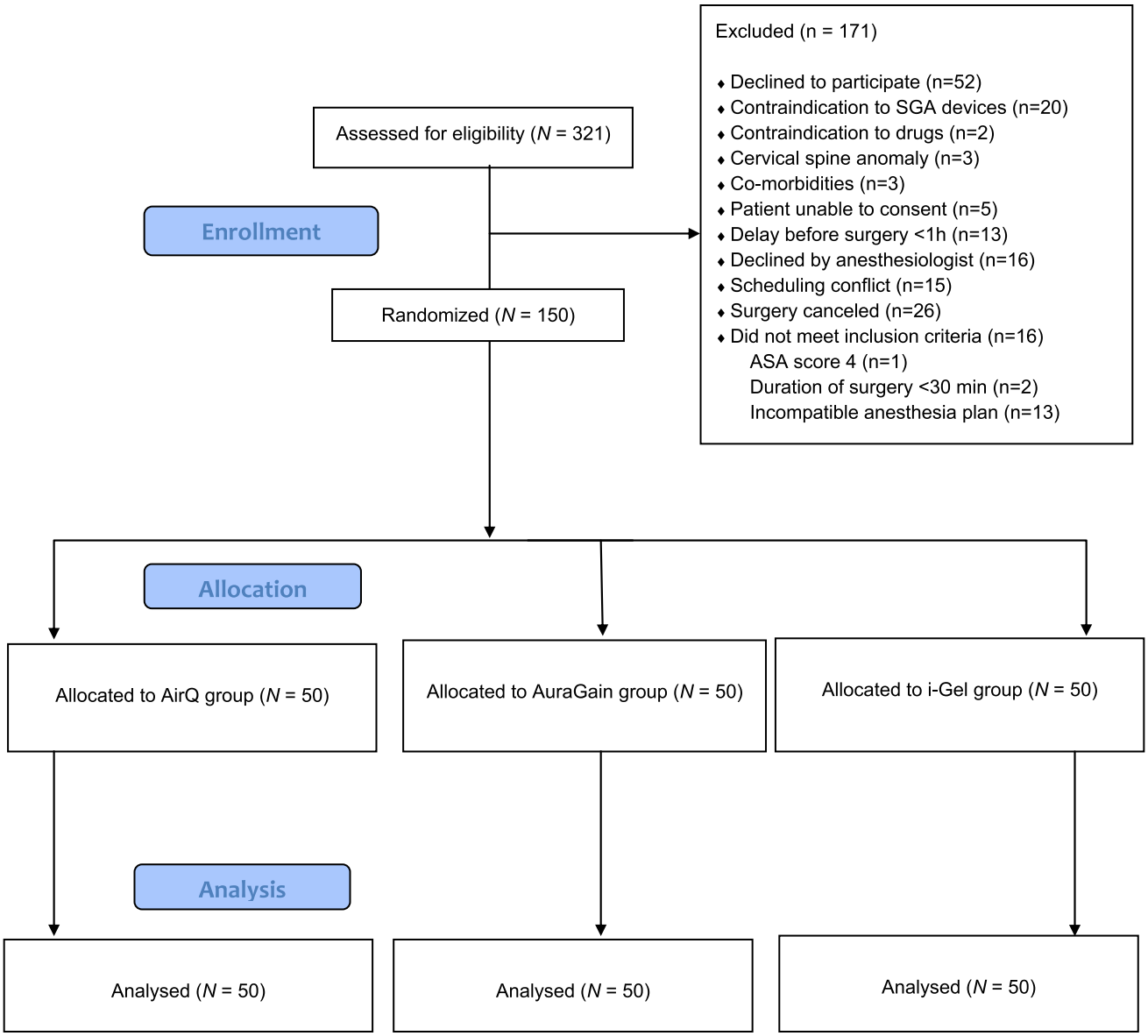


Fig. 1 Recruitment flow diagram. ASA = American Society of Anesthesiologists; SGA = supraglottic airway

Table 1 Supraglottic airway sizes and corresponding endotracheal tube sizes

	i-gel®	i-gel®	Air-Q® Blocker	Air-Q Blocker®	AuraGain™	AuraGain™
Size	4	5	3.5	4.5	4	5
Weight-based manufacturer recommendation (kg)	50–90	90+	50–70	70–100	50–70	70–100
Maximum ETT size	7.0	7.5	7.5	8.5	7.5	8.0

ETT = endotracheal tube

proceeding. Any correction maneuvers were noted. To avoid any mismatch between the inner diameter of the SGA and the outer diameter of the ETT, the size of the ETT (Covidien LLC, Mansfield, MA, USA) was preselected based on the model and size of the SGA. Each SGA manufacturer shares recommendations for ETT sizing, which was used as the first size in our in-house testing. If this test showed significant resistance despite a generous application of lubricating gel, the next smaller available size was tested (see Table 1).

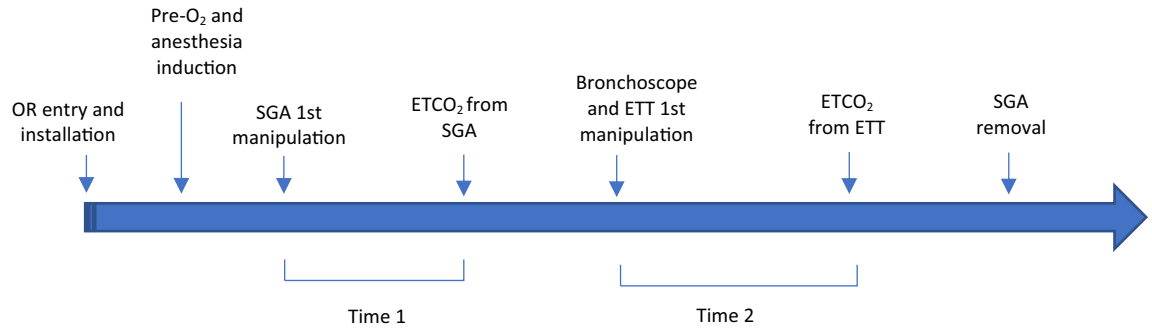


Fig. 2 Methodology and manipulations. $ETCO_2$ = end-tidal carbon dioxide concentration; ETT = endotracheal tube; Pre-O_2 = preoxygenation; OR = operating room; SGA = supraglottic airway

When the operator was ready, the bronchoscope, armed with the ETT, was inserted through the laryngeal port of the SGA and advanced toward the larynx. The bronchoscope was inserted until the carina was seen, and the ETT was railed along the bronchoscope until visualized in the trachea by the bronchoscope. The air cuff was inflated and the bronchoscope was removed. Next, the anesthesia circuit was connected and the presence of a normal expired CO_2 waveform was confirmed. As a last maneuver, the operator removed the SGA. The Air-Q® Stylet (Cookgas LLC, Mercury Medical, Clearwater, FL, USA), specifically designed for this purpose, was used across all groups because the other manufacturers offer no similar device.

Randomization

After eligibility screening, patients were randomly assigned in a ratio of 1:1:1 to the AuraGain, Air-Q Blocker, or i-gel using a permuted block of undisclosed and variable size. Allocation was concealed with sealed envelopes identified by a randomization code generated by a research coordinator with SAS 9.4 software (SAS Institute, Cary, NC, USA). The randomization was revealed once the patient entered the OR. Patients were blinded to group assignment. A research coordinator monitored the time of each manipulation, ease of SGA insertion, and ETT.

Outcomes

The primary outcome was the intubation time through the SGA devices, defined as the time between circuit disconnection from the SGA for the purpose of bronchoscope-guided intubation and the presence of expired CO_2 from the ETT (see Fig. 2). Intubation was measured in seconds with a stopwatch by a research coordinator in the OR.

Secondary outcomes included 1) success rate of adequate SGA insertion; 2) SGA insertion time; 3) ease of SGA insertion; 4) intubation success rate on first attempt; 5) overall success of intubation; 6) number of intubation attempts; 7) ease of intubation through the SGA; 8) laryngeal view grades during flexible scope-guided intubation; 9) ease of SGA removal with the ETT in place; and 10) any significant adverse events, including but not limited to desaturation defined as O_2 saturation $< 92\%$, accidental extubation, and dental injury.

Success rate of adequate SGA insertion, intubation success on first attempt, and overall success of intubation were all binary outcomes evaluated by the operators. Supraglottic airway insertion time corresponded to the time between the first handling of the SGA until the presence of expired CO_2, as measured by a stopwatch. Ease of SGA insertion, ease of intubation, and ease of SGA removal while leaving the ETT in place were evaluated by the operator using a three-level grading scale: easy, moderate, or difficult. An intubation attempt corresponded to one tentative railroading of the ETT on the flexible bronchoscope, and the laryngeal view grades were evaluated by the operator according to previous similar publications.[21] Any complications were also recorded.

Statistical analysis

Continuous variables were reported as means and standard derivations (SDs) if normally distributed (mean and median were equal), and as medians and interquartile range [IQR] otherwise. The statistical approach was conducted in two steps. First, we compared the three groups with a single two-sided test, with a level of significance of < 0.05. If significant, we conducted a second set of three pairwise analyses, comparing the groups head-to-head and identifying which group was distinct from the others. All statistical analyses were analyzed on an intention-to-treat basis and no subgroup analyses were conducted. We used the statistics software packages IBM SPSS for Windows version 24.0.0.0 (IBM Corp., Armonk, NY, USA), SAS 9.4 (SAS Institute, Cary, NC, USA), and R 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria).

Table 2 Characteristics of the patients at baseline

	Air-Q® Blocker *N* = 50	AuraGain™ *N* = 50	i-gel® *N* = 50
Female, *n*/total *N* (%)	30/50 (60%)	36/50 (72%)	40/50 (80%)
Age (yr), mean (SD)	53 (15)	53 (13)	56 (13)
BMI ($kg \cdot m^{-2}$), median [IQR]	28 [25–34]	26 [24–31]	27 [24–31]
ASA Physical Status, median [IQR]	II [II–III]	II [I–II]	II [II–III]
Mallampati score, median [IQR]	2[1,2]	1[1,2]	2[1,2]
Patil score > 6.5 cm, *n*/total *N* (%)	46/50 (92%)	43/50 (86%)	47/50 (94%)
Mouth opening > 3 cm, *n*/total *N* (%)	47/50 (94%)	49/50 (98%)	49/50 (98%)
Natural teeth, *n*/total *N* (%)			
Upper	35/50 (70%)	41/50 (82%)	38/50 (76%)
Lower	43/50 (86%)	42/50 (84%)	42/50 (84%)
Type of surgery, *n*/total *N* (%)			
Gynecologic	16/50 (32%)	20/50 (40%)	21/50 (42%)
General surgery	8/50 (16%)	8/50 (16%)	12/50 (24%)
Urologic	7/50 (14%)	4/50 (8%)	4/50 (8%)
Orthopedic	7/50 (14%)	4/50 (8%)	4/50 (8%)
Otolaryngology	4/50 (8%)	3/50 (6%)	2/50 (4%)
Neurosurgery	0/50 (0%)	4/50 (8%)	4/50 (8%)
Cardiac	4/50 (8%)	2/50 (4%)	2/50 (4%)
Plastic	3/50 (6%)	3/50 (6%)	1/50 (2%)
Other	1/50 (2%)	2/50 (4%)	0/50 (0%)
Operator, *n*/total *N* (%)			
Attending anesthesiologist	34/50 (68%)	38/50 (76%)	37/50 (74%)
Resident	16/50 (32%)	12/50 (24%)	13/50 (26%)

ASA = American Society of Anesthesiologists; BMI = body mass index; IQR = interquartile range; SD = standard deviation

For the three-arm analysis, we used a Kruskal–Wallis test to analyze intubation time. Secondary outcomes were analyzed with an ANOVA, Kruskal–Wallis, or Chi square test, according to the variable type and its distribution. If the three-group analysis revealed a statistically significant difference between groups with a P value < 0.05, we conducted three distinct pairwise analyses (Air-Q Blocker *vs* AuraGain; Air-Q Blocker *vs* i-gel; AuraGain *vs* i-gel). We used a Bonferroni correction to compensate for multiple analyses and a considered a P value < 0.017 as significant for these.[22] For the pairwise analyses, we used Chi square, Mann–Whitney, or Student's t test.

Sample size calculation

We calculated the sample size by estimating our intubation time to 36 sec, which corresponds to the average time from similar trials analyzing this outcome.[7, 23–26] To obtain sufficient statistical power, we used a SD of 13 sec corresponding to the highest SD reported in similar trials.[15] We required 45 patients per group for a two-tailed superiority trial with a power of 80%, an alpha error of 0.017, and a minimally significant clinical difference set to 25% (nine seconds). The alpha error of 0.017 was obtained by dividing the conventional alpha error of 0.05 by three, as described by the Bonferroni correction for three groups. The number of patients was raised to 50 per group in case of protocol break.

Results

One hundred fifty patients were enrolled and analyzed (Fig. 2). The mean (SD) age was 54 (14) yr; 106/150 (71%) were female, and the median [IQR] ASA Physical Status was II [II–III]. Most patients (57/150, 38%) had gynecological surgery, followed by general surgery (28/150, 19%). Baseline characteristics were similar between groups (see Table 1).

Primary outcome

The median [IQR] duration for intubation time was 44 [29–77] sec in the Air-Q Blocker group, 45 [32–58] sec in the AuraGain group, and 36 [24–51] sec in the i-gel group (P = 0.09). Despite the statistically nonsignificant

Table 3 Secondary outcomes

	Air-Q® Blocker $N = 50$	AuraGain™ $N = 50$	i-gel® $N = 50$	Three-arm P value
Successful SGA insertion,*n*/total *N* (%)	50/50 (100%)	49/50 (98%)	50/50 (100%)	1.0
SGA insertion time (sec), median [IQR]	16 [11–20]	16 [12–25]	10 [7–13]	< 0.001
SGA insertion ease, *n*/total *N* (%)				
Easy	33/50 (66%)	34/50 (68%)	47/50 (94%)	0.001
Moderate	16/50 (32%)	15/50 (30%)	3/50 (6%)	
Hard	1/50 (2%)	1/50 (2%)	0/50 (0%)	
Successful intubation on first attempt, *n*/total *N* (%)	38/50 (76%)	45/49 (90%)	46/50 (92%)	0.06
Overall success of intubation, *n*/total *N* (%)	47/50 (94%)	47/49 (94%)	50/50 (100%)	0.25
Ease of ETT passage through SGA, *n*/total *N* (%)				
Easy	28/47 (60%)	34/48 (71%)	37/49 (76%)	0.45
Moderate	15/47 (32%)	12/48 (25%)	11/49 (22%)	
Hard	4/47 (9%)	2/48 (4%)	1/49 (2%)	
Ease of SGA removal, *n*/total *N* (%)				
Easy	46/47 (98%)	40/47 (85%)	31/49 (63%)	< 0.001
Moderate	1/47 (2%)	5/47 (11%)	15/49 (31%)	
Hard	1/47 (2%)[a]	2/47 (4%)	3/49 (6%)	

Denominators that do not equal the sample sizes are due to missing data or unsuccessful prerequisite manipulations (i.e., intubation can't be attempted after unsuccessful SGA insertion)

[a] Removal was not attempted for this patient and was therefore considered hard

ETT = endotracheal tube; IQR = interquartile range; SGA = supraglottic airway

results, we calculated the 98% confidence intervals to appreciate the distribution of this primary outcome. These were 34 to 58 sec for Air-Q Blocker, 37 to 51 sec for AuraGain, and 30 to 44 sec for i-gel.

Secondary outcomes

Secondary outcomes are presented in Table 2. All three groups had similar SGA insertion success rates. The median [IQR] insertion time was significantly lower in the i-gel group than in the other two groups (i-gel, 10 [7–13] sec; Air-Q Blocker, 16 [11–20] sec, AuraGain, 16 [12–25] sec; $P < 0.001$ for both analyses). The i-gel was more often evaluated as "easy" to insert by the operators (Air-Q Blocker *vs* i-gel, $P = 0.001$; AuraGain *vs* i-gel, $P = 0.002$).

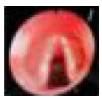
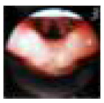
The success of intubation on the first attempt (i-gel, 92%; Air-Q Blocker, 76%; AuraGain, 90%; $P = 0.06$) and overall success of intubation (i-gel,100%; Air-Q Blocker, 94%; AuraGain, 94%; $P = 0.25$) were not significantly different between groups. The i-gel allowed a better visualization of the glottis than the Air-Q Blocker did ($P = 0.005$) while no significant differences existed between the i-gel and AuraGain and between the Air-Q and the AuraGain (Tables 3 and 4).

Finally, the Air-Q Blocker was considered easier to remove than the i-gel ($P < 0.001$) when leaving the ETT in the trachea. No differences in removal time existed between the i-gel and the AuraGain, or between the AuraGain and the Air-Q Blocker. Across all manipulations and for every patient, no significant adverse advents occurred.

Discussion

This trial compared three different second-generation SGA devices on the speed of bronchoscope-guided intubation through the SGA. No differences were found between the AuraGain, the Air-Q Blocker, and the i-gel. Insertion of the i-gel was faster and easier than the AuraGain and the Air-Q Blocker. The absolute reduction of six seconds for the i-gel insertion time was statistically significant, but the question of clinical relevance remains unanswered considering that all SGA devices led to adequate patient ventilation in 16 sec or less. The general impression of easier i-gel insertion is of greater interest. In urgent situations when an SGA is inserted for airway rescue, the easiness of the maneuver is important to maintain mental focus.[27] Our findings are aligned with those of a recent trial conducted in a military setting with 250 medics, only 35% of whom had ever placed an SGA in a real human.[28] They considered the insertion and manipulation of the i-gel easier than the Air-Q and LMA Fastrach. The easier manipulation of the i-gel might become more relevant if the operator is less experienced in airway management.

Table 4 Glottic view grading and results

Grade	Image	Structures visualized	Air-Q® Blocker $N = 50$	AuraGain™ $N = 50$	i-gel® $N = 50$	Three-arm P value
1		Only vocal cords, arytenoids, and base of epiglottis seen	21/48 (44%)	29/48 (60%)	36/49 (73%)	0.01
2		Vocal cords, arytenoids, and base and posterior surface of epiglottis seen	14/48 (29%)	10/48 (21%)	10/49 (20%)	
3		Posterior half of vocal cords and tip of epiglottis seen	4/48 (8%)	7/48 (15%)	3/49 (6%)	
4		Epiglottis down folded and its anterior surface seen	4/48 (8%)	0/48 (0%)	0/49 (0%)	
5		Epiglottis down folded, no part of vocal cords or glottic opening seen	5/48 (10%)	2/48 (4%)	0/49 (0%)	

Based on Pandey *et al*;[21] grading scheme and images reproduced with permission. Denominators that do not equal the sample sizes are due to missing data or unsuccessful insertion of supraglottic airway, a prerequisite to glottic view grading.

The results of our study and those of other recent similar trials suggest that the choice of second-generation SGA does not influence the intubation process. Lee *et al*. also conducted a three-arm RCT and, after comparing the Air-Q Intubating Laryngeal Airway (ILA) (Mercury Medical), the LMA® Classic™ (Teleflex), and the LMA® Unique™ (Teleflex), concluded that no significant differences existed in the intubation or the insertion time of these SGA devices.[25] Similarly, Mendonca *et al*. recently found no difference in intubation time between the i-gel and the LMA® Protector™ (Teleflex).[10] In a pediatric population, the Aura-i was compared with the Air-Q and provided similar success rates and insertion times.[14] Nonetheless, second-generation SGA devices are superior to the LMA Fastrach if fiber-optic guidance is used. In two recent studies conducted in adult patients, bronchoscope-guided intubation with the Air-Q and i-gel were compared with the LMA Fastrach and both had a shorter insertion time and gave a better view of the glottis, a surrogate outcome for SGA placement.[7, 29]

While the implicit objective of our trial was to identify which SGA should be readily available when managing airways, the manipulations during this trial were made in an elective surgical population, most of whom had no anatomic predictors of difficult airway management. Thus, it is unknown if the results apply to patients with known or suspected difficult airways. Randomized controlled trials conducted on patients with known difficult airways would be challenging because of their low incidence, the requirement of a first laryngoscopy to confirm the difficult intubation, and the potential urgency of the situation if the difficult airway was not suspected.

An interesting discussion point concerns the choice of SGAs studied in this trial. Similar trials recently used the LMA Fastrach, which was designed as a good intubation conduct and proved to be more efficient than the Air-Q for blind intubation.[13, 30] Nonetheless, flexible bronchoscopes are now widely available and are recommended for all intubations when using an SGA as a conduit.[8]

It is noteworthy to mention that this trial was conducted in a center when AuraGain and Air-Q Blocker were routinely available, while i-gel was introduced immediately before recruitment started. This confirms the steep, and thus very good, learning curve associated with using i-gel and other SGA devices, as described in previous publications.[31, 32] This could be exploited in prehospital care. Despite the uncertain long-term benefits of inserting SGA devices in prehospital settings and the conflictual improvement in ventilation, our results confirmed that SGA devices would also allow easy intubation upon arrival to the emergency department.[33, 34]

The strengths of this trial include the randomized controlled design, the three-arm approach (which is scarcely seen in RCTs), and the clinical relevance of

guiding the anesthesiologist on the choice of SGA to have readily available in the difficult airway cart. Moreover, we recruited clinicians with varying levels of experience, increasing the study's applicability to other settings. A limitation of the study is the selection bias caused by the recruitment of non-consecutive patients. More human resources would have been required to assess a consecutive set of patients. Another limitation is the performance bias in our study design because the operator and data collector were not blinded. This bias was minimized by real-time data collection.

Conclusion

In conclusion, we found that there were no significant differences in the time required for bronchoscope-guided intubation between the second-generation SGA devices, AuraGain, Air-Q, and i-gel; all intubations were performed within 198 sec. The i-gel was faster and easier to insert. Despite minor advantages of the i-gel, the clinician should select the SGA device as an intubation conduit according to their personal preferences.

Author contributions *Marie-José Colas* conceived the original idea of the study. *Marie-José Colas* initiated the study design and *Alexandre Dion*, *Éric Guimond*, *Frédérick D'Aragon*, *Pascal L. Langlois*, and *Yanick Sansoucy* helped with implementation. *Fannie Nadeau*, *Véronique Gagnon*, *Alexandre Dion*, *Éric Guimond*, and *Pascal L. Langlois* recruited the patients. *Pascal L. Langlois* was responsible for writing the protocol. *Frédérick D'Aragon* provided statistical expertise in clinical trial design. All authors contributed to refinement of the study protocol and the writing of the trial.

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