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Tips and tricks to increase the success rate of blind tracheal intubation through the Air-Q™ versus the intubating laryngeal mask airway Fastrach™

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KEYWORDS

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Abstract *Background:* The Air-Q intubating laryngeal airway is a new supraglottic airway device which overcomes some of the limitations inherent to the intubating laryngeal mask airway (ILMA Fastrach™) for tracheal intubation. Previous studies showed lower success rate of the Air-Q™ versus ILMA Fastrach™. This study was conducted to illustrate new maneuvers for increasing the success rate of Air-Q™ versus ILMA Fastrach™ and compare between both devices.

Methods: One-hundred and seventy adult patients, ASA I or II, aged >16 years old undergoing elective surgery under general anesthesia were divided randomly into 2 equal groups (85 each). Group A: using Air-Q ILA size 3.5 or size 4.5 Group B: using ILMA size 4 or size 5 according to the manufacturer's recommendations for body weight in both groups. The time and the total success rate of blind intubation through them in 2 attempts only were recorded. In Group A, extension of the head with cricoid pressure was applied. The hemodynamic response to devices insertion and the complications related to both devices were compared.

Results: In Group A, the total success rate in 2 attempts was 94.12%, while in Group B, it was 96.47%. However, this difference was not statistically significant. The first attempt success rate was 81.18% in Group A, while it was 82.35% in Group B. The total time to intubate the hemodynamic response to device insertion and the incidence of complications (sore throat, trauma and hoarseness of voice) showed no statistically significant difference between both groups.

Conclusion: This study showed that extension of the head with cricoid pressure greatly increases the success rate of blind intubation through the Air-Q to 94.12% versus the ILMA Fastrach 96.47% with no statistically significant difference between both devices.

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1. Introduction

Good practice and familiarity with a variety of airway techniques is essential for all anesthesiologists. They should be able to face any airway problem with solid instructions of information and experience. Recently, many supraglottic

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airway devices have been introduced in the clinical practice of the airway management to offer simple and effective alternatives to endotracheal intubation [1].

Both the American and the European Difficult Airway Societies recommend the use of laryngeal mask airway or the intubating laryngeal mask airway in an unanticipated difficult tracheal intubation [2].

The intubating laryngeal mask airway Fastrach™ (ILMA Fastrach) was introduced in 1997 to facilitate blind rather than fiberoptic assisted tracheal intubation [1].

The Air-Q intubating laryngeal airway (Cookgas LLC, Mercury Medical, Clearwater, FL) is a new supraglottic airway device which fulfills the criteria of ideal supraglottic devices which are ease of placement, reliable alignment of the glottic opening, and ability to continuously oxygenate and ventilate. It has several key structural differences from the ILMA; therefore, it has the potential to overcome the limitations of the ILMA: The Air-Q is available in six sizes (1, 1.5, 2, 2.5, 3.5, 4.5) in disposable single use form and in four sizes (2, 2.5, 3.5, 4.5) for reusable use. Thus, unlike the ILMA (sizes available: 3, 4, 5 only), the Air-Q devices are available in sizes small enough to allow its use in small children (<30 kg). Thus, the Air-Q ILA is currently the only available supraglottic device in pediatric patients designed to act as a conduit for tracheal intubations with cuffed tracheal tubes. Also, with Air-Q, intubation can be done with a standard normal size tube for age, while only a special straight cuffed silicone tube is used in ILMA. Lastly, if the Air-Q ILA failed as a conduit for the endotracheal tube, it can be left in place to ventilate through it, but this is not feasible with ILMA because of its metal part and its metal handle [3]. Unfortunately, previous studies had shown lower success rate of blind intubation through it [4–6]. For this reason, this study was conducted to illustrate tips and tricks for increasing the success rate of blind intubation through the Air-Q and compare ease of placement and success rate of blind intubation through the Air-Q ILA and ILMA – Fastrach devices, their hemodynamic responses and the incidence of complications.

2. Methods

After the approval of the medical ethics committee, this prospective, randomized study was conducted at Kasr Al Ainy Hospital, Faculty of Medicine, Cairo University on 170 adult patients. Patients were aged >16 years old, ASA physical status I or II scheduled for elective surgery under general anesthesia. Patients were not studied if they had respiratory or pharyngeal pathology, mouth opening <2.5 cm, were at risk of regurgitation, had a body mass index >30 kg/m^2, or were allergic to any drugs in the protocol. For patients with airway score >4 according to El-Ganzouri airway score [7], exclusion was done and the patient was prepared for awake fiberoptic intubation. Patients were assigned by computer generated randomization followed by opaque sealed envelope to one of two equal groups (85 for each). Group A: using Air-Q ILA size 3.5 for body weight (50–70) kg or size 4.5 for body weight (70–100) kg. Group B: using ILMA size 4 for body weight (50–70) kg or size 5 for body weight more than 70 kg according to the manufacturer's recommendations.

Written consent was obtained from every patient. The age, weight, sex, height, and BMI of patients were recorded. On arrival to the operating room, standard monitors were applied (electrocardiogram, noninvasive blood pressure, and pulse oximeter). Anesthesia was induced by intravenous fentanyl 2 μg/kg, propofol 2.5 mg/kg, and atracurium 0.5 mg/kg. Maintenance of anesthesia was done by isoflurane volatile anesthetic and atracurium. When neuromuscular blockade was complete (absence of response to train of four stimuli), the randomly assigned supraglottic airway was inserted by two of the authors who were of the airway team and committee in Kasr Al Ainy Hospital. The patients were randomly allocated to two equal groups using computer generated number and concealed using sequentially numbered, sealed opaque envelope technique.

Group A: the Air-Q ILA placement procedure was as follows: The Air-Q ILA cuff was deflated until two dimples appear at the back of Air-Q as described by manufacturer. The external surface and the cavity ridges were lubricated using lidocaine gel 2%. Then, the patient's mouth was opened, the mandible was held upwards and forwards as recommended by the manufacturer. This lifted the epiglottis away of the posterior pharyngeal wall and allowed the Air-Q ILA easy passage into the pharynx. Also, left displacement of the tongue together with lifting the mandible with the thumb of the left hand greatly facilitates its passage. The frontal portion of the Air-Q ILA was placed between the base of the tongue and the palate at a slight forward angle, if possible. The Air-Q ILA was introduced into the pharynx by gently applying inward and downward pressure, using the curvature of the ILA as a guide till fixed resistance to forward movement is felt. Correct placement was determined by the resistance to further advancement. The cuff was inflated according to the manufacturer's recommendation (15 ml for size 3.5 and 20 ml for size 4.5). Confirmation of proper position of the Air-Q ILA is done by adequate chest rise with no audible leak, by capnography and by leak pressure. Then, extension of the head with cricoid pressure is applied during the advancement of the well lubricated endotracheal tube. After ETT placement, inflation of the cuff and confirmation of its position are done by capnography. After that, the ETT connector was removed, and the Air-Q device was pulled out using a removal stylet to keep ETT in place while removing the Air-Q. Then, the ETT connector was placed into its position [1]. Auscultation of the chest to exclude endobronchial intubation is done in both groups with good taping of the tube. In both groups, the supraglottic airway device was immediately removed after confirmation of successful intubation. If the first attempt failed, reposition of the Air-Q with increasing lubrication of the ETT with lidocaine gel 2% was tried in the second attempt. If the second attempt failed, intubation was done by direct laryngoscopy.

In Group B, ILMA Fastrach placement procedure, the cuff of the ILMA Fastrach was deflated, and its posterior surface was lubricated using lidocaine gel 2%. The mask was held with its handle directed toward the feet of the patient, and then, the mask was inserted into the patient's mouth with circular movement maintaining contact against palate and posterior pharynx. The mask was advanced till resistance is felt. The cuff of the mask was inflated according to the manufacturer's recommendation. The mask was connected to the anesthesia circuit to confirm good position of the mask as in Group A. Then, the lubricated specially designed silicone ETT was inserted through the mask blindly, and its cuff was inflated. Confirmation of proper position was done by capnography. After

that, the ETT connector was removed, and the ILMA Fastrach device was removed out by gently pulling the handle caudally using stabilizing rod to keep ETT in place while removing the LMA Fastrach device. Then, the ETT connector was placed into its position and ventilation started. Auscultation of the chest was done as in Group A. If the first attempt failed, another trial was done after applying gentle rotation of the handle in and out or side to side until ventilation was adequate according to the manufacturers' recommendations and re-intubation was tried. No third attempt was allowed.

The following parameters were recorded:

- The success rate of insertion of each device to achieve adequate ventilation.
- The total success rate of blind tracheal intubation through each device.
- The success rate of the first and second trial of blind tracheal intubation through each supraglottic device.

The following times were recorded by an observer using a stop watch: *first*: the insertion time of the study device from the moment the device entered the mouth until the appearance of the capnograph waveform. If there was a second attempt, the insertion time was the sum of the 2 attempts. This did not include the gap time between attempts. *Second*: the insertion time of the tracheal tube from the moment of insertion of the tracheal tube through the study device until the appearance of the capnograph waveform. If there was a second attempt, the insertion time was the sum of the 2 attempts. *Third*: the total time from the moment the supraglottic airway was placed until after it was removed with correct placement of the tracheal tube.

Hemodynamics: the heart rate and the mean blood pressure were recorded before and one minute after insertion of each supraglottic device.

Complications such as trauma to the airway were noted by blood on the device during its removal; sore throat was graded to mild, moderate, and severe by asking patients in the post-anesthesia care unit. Hoarseness of voice was also noted.

2.1. Sample size calculation

Power analysis showed that a total sample size of 170 patients, randomly allocated into two equal groups (85 patients in each group), would be needed to detect a clinically significant difference of 15% or more in the overall success rate of intubation between both groups. The test statistic used is the two-sided Fisher's Exact test with a power level of 82% and a significance level (α) of 0.05. Estimation of sample size was performed by using computer program G*Power 3 for Windows. (Franz Faul, Universität Kiel, Germany).

2.2. Statistical methods

Data management and analysis were performed using Sigma Stat program, version 3.5 (Systat Software, Inc., USA). The graphs were done using Microsoft Excel 2007. The numerical data were statistically presented in terms of mean and standard deviation. Categorical data were summarized as percentages.

Table 1 Demographic Data.

Variable	Group A (Air-Q ILA) (n = 85)	Group B (ILMA) (n = 85)	P-value
Sex distribution:			
Male (n & %):	40 (47.1)	39 (45.9)	0.878
Female (n & %):	45 (52.9)	46 (54.1)	
Age (years)			
Mean ± SD	41.6 ± 13.4	40.7 ± 12.4	0.627
Weight (kg)			
Mean ± SD	71.2 ± 9.4	70.5 ± 9	0.611
Height (cm)			
Mean ± SD	166.4 ± 8.1	168.1 ± 9.1	0.211
BMI			
Mean ± SD	25.7 ± 2.7	24.9 ± 2.7	0.076

n = number of patients. BMI = body mass index.
*Statistically significant between-group difference ($P < 0.05$).

Table 2 Comparison of success rate of intubation between both groups.

	Group A (n = 85) (Air-Q ILA)	Group B (n = 85) (ILMA)	p-value
Overall success rate	80 n (94.12%)	82 n (96.47%)	0.717
Total failure rate	5n (5.88%)	3n (3.53%)	
First attempt (n)	69 n (81.18%)	70 n (82.35%)	0.949
Second attempt	11 n (12.94%)	12 n (14.12%)	

n = Number of patients.
*Statistically significant between-group difference ($P < 0.05$).

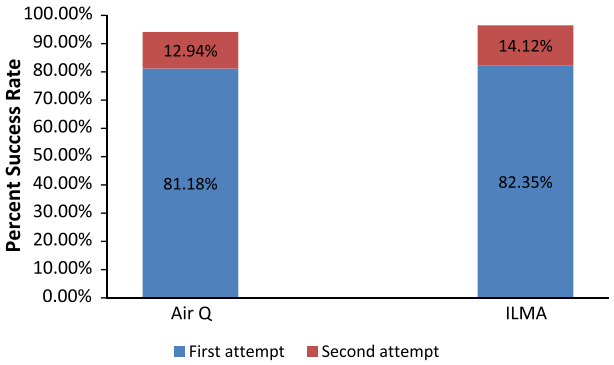

Figure 1 Total success rate of tracheal intubation attempts in both groups.

Comparisons between numerical variables of two groups were done by unpaired Student's *t*-test for parametric data or Mann–Whitney Rank Sum test for nonparametric data. Comparisons between numerical variables at pre- and post-device insertion were done by Student's paired *t*-test for parametric data or Wilcoxon Signed Rank Test for nonparametric data.

Comparing categorical variables were done by Chi-square test or Fisher exact test for small sample size. *Z*-test (at a confidence interval of 95%) was used for comparing single proportions.

All *p*-values were considered significant when *P*-values were less than 0.05.

3. Results

As regards the demographic data, there was no significant difference between the 2 groups (see Table 1).

As regards the success rate of insertion of both devices, all patients were adequately ventilated by both devices with the exception of one patient in the Air-Q group and one patient in the ILMA group who were inadequately ventilated and there was a great leak. These cases were counted with the failure rate of each device.

Total failure rate is the sum of failure of insertion of the device and failed blind intubation through it. In Group A, 1 failed device insertion plus 4 failed blind intubation. In Group B, 1 failed device insertion plus 2 failed blind intubation through it.

There was no statistically significant difference in the overall success rate of both groups ($p > 0.05$) (Table 2 and Fig. 1). The overall success rate in Air-Q was 94.12% while in ILMA Fastrach was 96.47% with no statistically significant difference. The first time success rate in Group A was 81.18%, while in Group B, it was 82.35%, but the difference was not statistically significant.

As regards the time of insertion of the two study devices, the total time to intubate was longer in Group B than in Group A, but this difference was not statistically significant ($p > 0.05$) (Table 3).

As regards the hemodynamics (HR and mean blood pressure), there was not any significant difference between Air-Q and ILMA Fastrach (Table 4).

Also, in each group, there was not any significant increase in heart rate or mean blood pressure after insertion than the pre-insertion values (Tables 5 and 6).

The incidence of complications in the form of blood on the device, sore throat, and hoarseness of voice showed no statistically significant difference among the groups ($p > 0.05$). Sore throat was graded as mild in 20 patients and moderate in 5 patients in Group A, while in Group B, it was graded as mild in 13 patients and moderate in 7 patients (Table 7).

Removal of the two devices after successful intubation was easy without displacement of the tracheal tube in any patient.

4. Discussion

When difficulties in airway management arise, patients do not die from failure to intubate but from failure to oxygenate. For this reason, it is recommended to use any of the supraglottic devices as a plan B to ventilate the patient, and if the condition necessitates endotracheal intubation, these devices can also be used as a conduit for the endotracheal tube.

Extensive practice is not needed in using supraglottic devices as opposed to endotracheal intubation, and this will make anesthesia practice much easier and safer.

This study showed a higher success rate (94.12%) of blind tracheal intubation through the Air-Q than previous studies [4–6]. This may be contributed to many factors: extension of the head with cricoid pressure mainly and reposition of the Air-Q with increased lubrication of the ETT with lidocaine gel 2% in the second trial and by increased training. The use of a bougie was also described before, but it was not tried in this study. The success rate for ILMA was 96.47%, which coincides with previous studies [5,6]. The high success rate of blind intubation through ILMA Fastrach in the neutral position may be very valuable in cervical spine injury.

José et al. [4] had studied the comparison between the Air-Q, ILMA, and i-gel. They reported a success rate of blind tracheal intubation through the Air-Q (60%), through the ILMA (70%), and through the i-gel (40%). They explained this low success rate by lack of use of any repositioning maneuvers described by other authors to avoid down folding of the epiglottis. For ILMA, raising the mask upward (Chandy maneuver), partial withdrawal, pull up or push down maneuver, rotating the tube bevel, and adjusting head and neck position. For Air-Q, they did not use Klein maneuver (jaw lift and withdrawal of the Air-Q followed by reinsertion). All patients were

Table 3 Comparison of time of insertion of the two study devices in seconds.

Variable (second)	Group A Air-Q (mean ± SD)	Group B ILMA (mean ± SD)	*P*-value
Insertion time of the device	27.6 ± 9.5	25 ± 11.3	0.36456
Insertion time of the tube*	29.7 ± 12	40.3 ± 14.6	0.00002
Total time	78.4 ± 20.8	83.9 ± 12.9	0.09432

* Statistically significant between-group difference ($P < 0.05$).

Table 4 Comparison of hemodynamic changes between both groups.

Variable	Group A Air-Q (mean ± SD)	Group B ILMA (mean ± SD)	*P*-value
HR before device insertion	69.2 ± 10.9	65 ± 8.5	0.0866
HR after 1 min of device insertion	73.4 ± 11.7	71 ± 7.3	0.1247
Mean BP before device insertion	80.5 ± 7.4	75.3 ± 9.6	0.2108
Mean BP after 1 min of device insertion	85.3 ± 5.9	79.4 ± 6.8	0.3489

HR = heart rate. BP = blood pressure.
*Statistically significant between-group difference ($P < 0.05$).

Table 5 Comparison of hemodynamic changes before and after Air-Q insertion.

Air-Q group	Before device insertion	After device insertion	*P*-value
HR	69.2 ± 10.9	73.4 ± 11.7	0.07821
Mean BP	80.5 ± 7.4	85.3 ± 5.9	0.06893

HR = heart rate; BP = blood pressure.
*Statistically significant between-group difference ($P < 0.05$).

Table 6 Comparison of hemodynamic changes before and after ILMA insertion.

ILMA group	Before device insertion	After device insertion	*P*-value
HR	65 ± 8.5	71 ± 7.3	0.05932
Mean BP	75.3 ± 9.6	79.4 ± 6.8	0.06729

HR = heart rate; BP = blood pressure.
*Statistically significant between-group difference ($P < 0.05$).

Table 7 Complications of Both Groups.

Variable	Group A (Air-Q)	Group B (ILMA)	*P*-value
Sore throat	25/80	20/82	0.424
Blood on the device	10/80	8/82	0.759
Hoarseness of voice	3/80	2/82	0.977

*Statistically significant between-group difference ($P < 0.05$).

intubated in the neutral position. They compared the glottic view through each device by the use of fiberoptic bronchoscope according to Brimacombe score [8] and reported better glottic view with Air-Q than ILMA and i-gel, but this finding was not translated into greater success in blind intubation because of the reasons discussed before.

Karim and Swanson [5] had studied this comparison; they reported a success rate of 99% with ILMA versus 77% with Air-Q. Fiberoptic intubation was used in the third attempt which increased the success rate to 100% in the ILMA, and to 95% in Air-Q. The success rate of Air-Q (77%) was attributed to the use of a bougie in most re-insertion attempts, but they did not record in which patients. Also, they described that the device was withdrawn 5–8 cm with mandibular lift during reinsertion of the Air-Q in the second attempt, but they did not use the head extension with cricoid pressure technique as we used in this study which increased the success rate to 94.12%.

Neoh and Choy [6] had compared blind intubation through the Air-Q and ILMA Fastrach™. The success rate within three attempts was 75% with Air-Q and was 97.47% with ILMA with no statistically significant difference. The neutral position was used in both groups. They postulated that the ILMA had a higher success rate compared to Air-Q due to better maneuverability for alignment, easier ETT passage, and softer and more flexible supraglottic cuff.

El-Ganzouri et al. [9] recorded that the Air-Q can be used as an excellent ventilatory device as well as a conduit for endotracheal intubation with a standard tube either blindly (success rate 70%) or by the aid of fiberoptic bronchoscope. They explained this low success rate by being nonfamiliar with the new device and by getting more experience; the success rate would be increased in subsequent studies.

Erlacher et al. [10] also studied two types of Air-Q ILA {CobraPlus and Cookgas Air-Q} as a facilitator for blind intubation versus the Fastrach ILMA (success rate in CobraPLUS Air-Q was 47% and in Cookgas Air-Q was 57% while in Fastrach ILMA was 95%). They found that all these supraglottic devices are safe in general anesthesia with a low potential for traumatization.

Pandit et al. [11] had studied blind intubation through the intubating laryngeal mask airway and recorded less success rate with blind intubation with a dedicated 7 mm silicone tracheal tube through the ILMA (75%) than with fiberoptic intubation with a dedicated 7 mm silicone tracheal tube through

the ILMA (95%) and fiberoptic intubation with a 6 mm reinforced tracheal tube through a standard laryngeal mask airway (80%).

As regards the ease of insertion and the potential for traumatization to the airways, considerable friction was noted during the passage of ETT through the Air-Q, which was not noted with ILMA. The occurrence of blood and sore throat in Group A was greater than Group B, which was not statistically significant. This can be explained by the more rigid cuff of Air-Q than the silicone cuff of the ILMA. Also, the standard conventional ETT is more rigid than the silicone cuff of the ILMA tube. However, many factors may be attributed to sore throat and hoarseness of voice: the depth of anesthesia, the method of insertion, the cuff volume, the number of insertion attempts, and post-operative analgesia [4].

As regards the time of device insertion, tube insertion, and the total time to intubate, the total time was longer in ILMA Fastrach than in Air-Q, but this was not statistically significant.

Swanson et al. [12] had studied the intubating laryngeal airway in comparison with laryngeal mask airway; they found no difference in placement time or sore throat.

As regards the hemodynamics, this study concluded that insertion of supra-glottic devices was associated with less hemodynamic response; no significant increase in heart rate or mean blood pressure after insertion than the pre-insertion values. Also, there was not any significant difference between Air-Q and ILMA Fastrach.

Martin Kahl et al. [13] had studied the stress response to tracheal intubation in patients undergoing coronary artery surgery and compared between direct laryngoscopy and ILMA. They concluded that reduction in cardiovascular and endocrine stress response was more pronounced when performed through the ILMA.

The hemodynamic response to supra-glottic airway devices (I-gel, proseal LMA, and classic LMA) was studied by Wonlung Shin et al. [14]. They concluded that the mean blood pressure and heart rate after insertion of these devices were significantly decreased when compared with those before the induction of anesthesia. There was no significant difference among the three groups.

On the contrary, Zhang et al. [15] had compared the hemodynamic response to ILMA and direct laryngoscopy. They concluded that both devices produce similar hemodynamic response. Also, Ismail et al. [16] had studied the hemodynamic response to insertion of the I-gel, laryngeal mask airway, or endotracheal tube. They concluded that LMA insertion was associated with significant increase in heart rate and systolic blood pressure. Insertion of I-gel causes better hemodynamic stability than the others.

These results could be explained by the jaw thrust that is frequently used for insertion of supraglottic devices. Jee et al. [17] had studied 40 patients under general anesthesia by maintaining the patients' airway with jaw thrust for 4 min, and the lungs were ventilated through a Patil-Syracuse endoscopy. They concluded that jaw thrust maneuver with adequate force causes significant sympathetic responses during induction of general anesthesia, and this could explain the different results.

Limitation of the study: blinding was impossible for the assessor during evaluating the efficacy, BMI was less than 30 kg m^2, and inexperienced clinicians were not participating in the study and exclusion of patients with difficult airways.

For future studies, Air-Q™ Sp, invented by D. Cook, is a new self-pressure version of the Air-Q™ ILA, available now in a reusable form that presents combined features of the Air-Q™ (ILA) but without a pilot balloon inflation cuff. It may increase the success rate together with decreasing the intra-cuff pressure related complications. Also, more work should be done in patients with difficult airways.

5. Conclusion

This study showed that extension of the head with cricoid pressure greatly increases the success rate of blind intubation through the Air-Q to 94.12% versus the ILMA Fastrach 96.47% with no statistically significant difference between both devices.

Conflicts of interest

None.

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