Original Article

Comparison of success rate of intubation through Air-Q with ILMA using two different endotracheal tubes

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Access this article online
Website: www.ijaweb.org
DOI: 10.4103/0019-5049.179448
Quick response code

ABSTRACT

Background and Aims: Air-Q™ is a newly introduced airway device, which can be used to facilitate endotracheal intubation. The primary aim of this study was to assess whether use of two different endotracheal tubes (ETTs) (standard polyvinyl chloride [PVC] and reinforced PVC) increases the success rate of blind intubation through Air-Q™ (Group Q) when compared with intubating laryngeal mask airway (ILMA- Fastrach™) keeping ILMA as control (Group I). **Methods:** One hundred and twenty patients aged between 18 and 60 years with American Society of Anesthesiologists physical status I-II, undergoing elective surgery under general anaesthesia, were enrolled into this prospective, randomised, case–control study to compare the success rate of tracheal intubation between ILMA (Fastrach™) and Air-Q™ intubating laryngeal airway. Those patients with anticipated difficult airway were excluded from the study. All the recruited patients completed the study. Reinforced PVC ETT was used in both airway devices to secure intubation. Since standard PVC tube is recommended for use in Air-Q, when first intubation attempt failed, second or third attempt was made with standard PVC ETT. Total of three attempts were made for each procedure: Whereas in ILMA group, only reinforced tube was used in all three attempts. **Results:** The overall success rate after three attempts was more with Air-Q (96.6%) in our study compared with ILMA (91.6%) but no significant difference was seen between the groups ($P = 0.43$). **Conclusion:** The present study shows that when intubation with reinforced tube fails, the success rate with use of conventional PVC tube is more with Air-Q when compared with ILMA.

Key words: Air-Q intubating laryngeal airway, intubating laryngeal mask airway, endotracheal intubation, laryngeal mask airway, Fastrach™, supraglottic airway devices

INTRODUCTION

Most of the surgical procedures are performed under general anaesthesia which usually requires endotracheal intubation. The laryngeal mask airway (LMA) may be used to provide a routine airway for use during general anaesthesia or less commonly as a conduit for tracheal intubation.[1]

The intubating LMA (ILMA) ™ or LMA Fastrach™ was designed specifically to facilitate tracheal intubation while maintaining ventilation.[2] The ILMA overcomes the diameter-length limitations for tracheal tube (TT) imposed by classic LMA and facilitates guidance of the TT towards the glottis.[3] However, the ILMA has certain limitations. The breathing tube is rigid, which makes it difficult for prolonged use as a supraglottic airway and may cause pressure necrosis in the posterior pharyngeal wall. It also requires the use of expensive (high pressure cuffed, reinforced) silicone TT. It cannot be used for paediatric population. One alternative device to ILMA to facilitate intubation is Air-Q (Cookgas, St. Louis, Missouri, USA), also known as the Intubating Laryngeal Airway™ (ILA).[4]

How to cite this article: Malhotra SK, Bharath KV, Saini V. Comparison of success rate of intubation through Air-Q with ILMA using two different endotracheal tubes. Indian J Anaesth 2016;60:242-7.

The advantages of the Air-Q over ILMA are that the breathing tube of the device is shorter, wider and due to the removable connector, a standard endotracheal tube (ETT) can be easily placed. The inexpensive polyvinyl chloride (PVC) TT is the one recommended for use with Air-Q whereas, in ILMA, the TT is specific and expensive, as mentioned above.[4] The primary aim of the present study was to assess whether use of two different ETTs (standard PVC and reinforced PVC) increases the success rate of blind intubation through Air-Q when compared with ILMA (control group).

METHODS

This was a prospective, randomised, interventional study of two supraglottic airway devices, namely ILMA™ and the Air-Q™ airway for endotracheal intubation. Institutional Ethical Committee approval and written informed consent from subjects was taken. The study was conducted between January 2013 and December 2013 by three persons having, at least, 1½ year experience in anaesthesia and who had used the airway devices (ILMA or Air-Q) more than 10 times before commencement of the study. Patients with age group of 18–60 years, weight 50–70 kg, American Society of Anesthesiologists (ASA) physical status I-II, scheduled for elective surgical procedures needing tracheal intubation were included in the study. A total of 120 patients of either sex were randomised into two groups of 60 each, Group I (ILMA) and Group Q (Air-Q) based on computer-generated random number table. Patients with suspected or known difficult intubation or ventilation, patients with mouth opening of <4 cm, those with a history of symptomatic gastroesophageal reflux or increased risk of aspiration were excluded from the study.

Baseline heart rate (HR), non-invasive blood pressure and oxygen saturation (SpO_2) of patients were recorded. Induction of anaesthesia was done using 2 μg/kg fentanyl and propofol 2 mg/kg and then neuromuscular monitoring was commenced. Vecuronium 0.1 mg/kg was administered after confirming mask ventilation. Anaesthesia was maintained with propofol infusion (150 μg/kg/min) and 100% oxygen with fresh gas flow set at 4 L/min. The supraglottic device was inserted after complete neuromuscular blockade (train of four [TOF] count 0) according to the group allocation.

The following sizes of ILMA and Air-Q airway and TTs were used in the present study based upon the weight of the patients: ILMA: Size 4 and reinforced cuffed PVC ETT (Rusch GmbH, Kernen, Germany) of size 7.5 ID, Air-Q: Size 3.5 with reinforced cuffed PVC ETT of size 7.5mm ID. We compared the angle of emergence of TTs in ILMA and Air-Q. The angle of emergence of TT is nearly 45° in ILMA as compared to 25° in Air-Q [Figure 1]. Both the reinforced and standard PVC tube formed almost same angle with Air-Q.

The patient's head was placed in neutral position and the device inserted by one-handed rotational movement in the sagittal plane. The cuff of ILMA was fully deflated with the rim facing posteriorly; lubricating jelly was applied posteriorly to the distal saucer-shaped tip and is then flattened against the palate. When the saucer-shaped depression was seen inverted against the palatal surface, it was drawn slightly backwards to ensure complete flattening of the rim into the doom of the palate before pushing the device forwards. The ILMA was then rotated inwards along the arc of the palate and posterior pharyngeal wall. After inserting, ILMA cuff was inflated with air (30 ml air in ILMA size 4).

For patients assigned to the Air-Q group, size 3.5 device was placed based on weight of the patient. Head of the patient was kept in neutral position. Using a tongue depressor, the tongue was pushed towards the floor of mouth. This manoeuvre helped to create adequate space for the insertion of the device. The device was then placed in the patient's mouth and using index finger of the operator's left hand the tip of the cuff was guided along the base of the tongue. A caudal force was applied with the operator's right hand over the shaft and the device was rotated inwardly along the arc of palate and posterior pharyngeal wall. A jaw lift

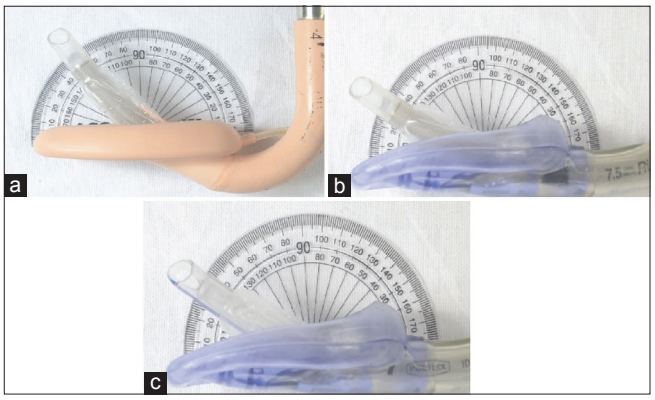

Figure 1: (a) Angle of emergence of the reinforced PVC tracheal tube from ILMA. (b) Angle of emergence of the reinforced PVC tracheal tube from Air-Q. (c) Angle of emergence of the standard polyvinyl chloride endotracheal tube from Air-Q

with the operator's left hand was performed if initial resistance to advancement was encountered while the device was rotated inwardly and forwards into proper position with the right hand. When advancement met a firm stop, adequate ventilation through the device was confirmed, defined as measurement of $EtCO_2$ on the anaesthesia monitor and observation of adequate chest rise with manual ventilation using the breathing bag of the anaesthesia workstation.

If a second attempt was required, the manufacturers' instructions were followed. For the LMA Fastrach™, this meant applying the Chandy's manoeuvre (partial withdrawal, pushing down in a sagittal plane and raising the mask upwards).[5] For the Air-Q, the device was withdrawn 5–8 cm with mandibular lift and again reinserted checking for adequate ventilation. A size 7.5 cuffed wire-reinforced TT was inserted through either of the device after lubrication with a water soluble lubricant. Intubation was confirmed 'successful' by checking for ventilation and monitoring end tidal carbon dioxide. The choice of ETT for intubation during second attempt in Air-Q depended upon first failed attempt. If resistance was met for intubation during first attempt, second attempt was made with reinforced tube (standard PVC tube if ETT slipped into oesophagus during first attempt). If third attempt was required, standard PVC tube was used. Whereas reinforced tube was used in all three attempts in ILMA. The specific intubating airway device was removed immediately after confirmation of successful intubation. In ILMA group patients, the LMA cuff was deflated and using the stabilizer to support the tracheal tube the device was taken out. In patients with Air-Q, cuff deflation was not required. It was removed with the help of stylete provided along with the device. The ETT cuff was not deflated during removal of either of the device. If the specific airway device was not placed in three attempts, or SpO_2 fell to 90%, direct laryngoscopy was utilised for endotracheal intubation.

Haemodynamic parameters were noted for the duration of 10 min after intubation. On completion of the surgical procedure, propofol infusion was stopped. Neuromuscular blockade was reversed at the TOF count 3 or 4 with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg. When the TOF ratio reached 90%, ETT was removed and patient responsiveness assessed.

The insertion time (time in seconds from starting to insert the airway [ILMA or Air-Q] till appearance of capnography waveform), intubation time (time in seconds from starting insertion of the TT until obtaining capnography waveform), ease of insertion/intubation (easy, moderate [minimal resistance], difficult [significant resistance] or impossible), the total time (from the moment the intubating airway was placed until it was removed with correct placement of TT after verified by capnography), number of insertion/intubation attempts (maximum of three attempts were allowed before considering the device insertion/intubation a failure).

Parameters for stress response (baseline HR, systolic blood pressure [SBP], mean arterial pressure [MAP] and diastolic blood pressure [DBP]) were noted and subsequently pre-intubation and post-intubation values immediately and after intervals of 1, 2, 3, 4, 6, 8 and 10 min were noted.

Adverse events during the procedure like desaturation (SpO_2 < 92%), bronchospasm, laryngospasm, failure to insert device or grossly visible blood on device after removal were noted. Post-operative complications such as sore throat, dysphagia and hoarseness (immediately and after 24 h) were also noted.

The Statistical Package for Social Sciences 15 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Blind intubation through Air-Q using PVC ETT has a success rate of 77% and 57% respectively based on two previous studies.[4,6] It was assumed that use of two different ETTs will have the success rate of 75% with Air-Q for blind endotracheal intubation in three attempts. We know that ILMA has a success rate of 95.7% for intubation.[7] We had to study 54 experimental subjects and 54 control subjects to be able to reject the null hypothesis that the success rates for experimental and control subjects are equal with probability (power) 0.8. The Type I error probability associated with this test of null hypothesis is 0.05.

The success rate of blind endotracheal intubation between the two groups (ILMA vs. Air-Q) was compared using Fisher's exact test. Kolmogorov–Smirnov test was applied to determine the normality of measurable data. For comparing number of insertion/intubation attempts and ease of insertion/intubation Chi-Square test was applied. For skewed data (time of insertion/intubation and total time), Mann–Whitney U-test was applied. All non-parametric data were expressed as median and inter-quartile range. All parametric data was expressed as mean + standard deviation. Continuous variables such as HR, SBP,

DBP and MAP were compared with Student's *t*-test. $P < 0.05$ was considered significant.

RESULTS

Baseline characteristics in both the groups had no significant difference in terms of age, sex, weight, ASA status, modified Mallampatti classification and thyromental distance [Table 1]. The overall success rate for intubation through the device in our study is 91.6% in ILMA [Table 2] and 96.6% in Air-Q group. However, the first attempt success rate for intubation was more with ILMA as compared to Air-Q (75% vs. 65%, $P = 0.23$). There was no statistically significant difference in HR, SBP, MAP and DBP between both the groups at baseline, pre-intubation and at intubation. No significant difference in HR [Figure 2] was seen in both groups post-intubation. MAP had a significant difference only at 2 min after intubation [Figure 3] which was more in ILMA group.

Six patients in ILMA and 4 in Air-Q group had significant visual analogue scale score (>3) for sore throat in immediate post-operative period which was reduced after 24 h. Three patients in each group had dysphagia whereas hoarseness was noted in 5 and 4 patients of group I and group Q respectively. Three patients in ILMA and four in Air-Q developed bronchospasm as observed by capnograph tracing which resolved after the use of bronchodilators. Grossly visible blood on device after removal was seen in one patient in each group. No patient in either of the groups had laryngospasm. None of the patients had episode of desaturation ($SpO_2 < 92\%$) during the course of intubation.

Table 1: Demographic characteristics. Values are in mean±SD or number (proportion)

	Group I (ILMA) (*n*=60)	Group Q (air-Q) (*n*=60)	*P* value
Age (years)	41.71±12.16	39.36±12.79	0.30
Weight (kg)	59.86±6.73	59.73±6.97	0.91
Male: female	25:35	29:31	0.46
ASA physical status (I: II)	45:15	44:16	0.83
MMP (I: II)	12:48	16:44	0.52
TMD (cm)*	7±1	7±1	0.84

MMP – Modified Mallampatti classification, TMD – Thyromental distance (*median value) (Student's *t*-test: Age, weight and TMD; Chi-Square test: Sex ratio and ASA – American Society of Anesthesiologists physical status)

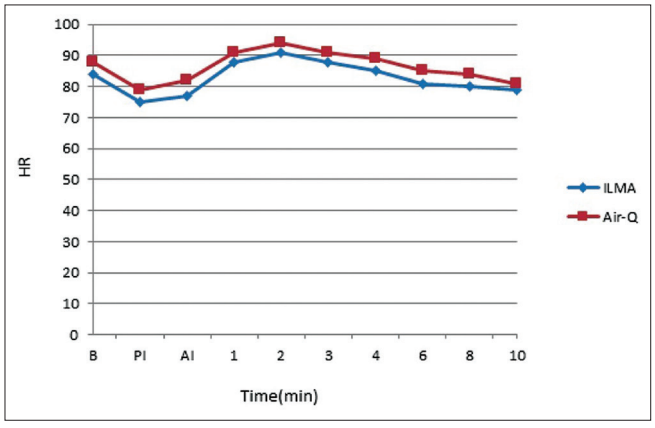

Figure 2: Heart rate (beats/min) response during intubation between Air-Q and ILMA (B: Baseline, PI: Pre-intubation, AI: At intubation)

DISCUSSION

The increase in success rate with Air-Q in our study is due to using conventional PVC tube for subsequent attempts in Air-Q whereas in ILMA reinforced tube was used in all three attempts though this difference is not statistically significant. In our study, we used standard PVC tube in 9 patients of Air-Q group for successful intubation when intubation with reinforced tube failed (4 in second and 5 in third attempt). In 10 patients reinforced tube was used in second attempt for succesful intubation in Air-Q group. Five patients in ILMA and 2 patients in Air-Q group could not be intubated through respective devices, hence direct laryngoscope was used. All the patients who had failed intubation had (Cormack and Lehane) grade of either I or II and no difficulty was seen during direct laryngoscopy.

In a previous pilot study of 59 patients, Air-Q ILA was successfully inserted in 100% of patients.[8] In a full scale study, the rate of successful intubation after two blind attempts was found to be 99% in the LMA Fastrach™ group and 77% in Air-Q group[4] Air-Q had a success rate of 75% within three attempts whereas in ILMA it was 97.4% in study by Neoh and Choy.[9] Three intubating airway devices were compared for blind

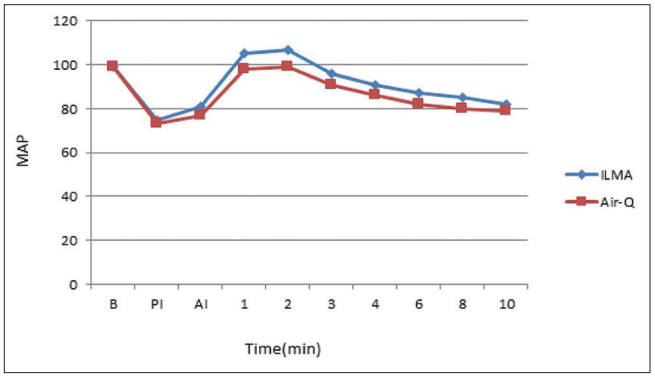

Figure 3: Mean arterial pressure (mm Hg) response during intubation between Air-Q and intubating laryngeal mask airway (B: Baseline, PI: Pre-intubation, AI: At intubation)

Table 2: Insertion and intubation characteristics

Insertion/Intubation characteristics	Group I (*n*=60)	Group Q (*n*=60)	*P*
Number of insertion attempts (%)			
One	53 (88.3)	56 (93.3)	0.32
Two	5 (8.3)	4 (6.6)	
Three	2 (3.3)	0 (0)	
Time taken to place the device (s)†	30±15	15±5	0.00*
Ease of insertion			
Easy	52 (86.6)	55 (91.6)	0.63
Moderate	7 (11.66)	4 (6.6)	
Difficult	1 (1.6)	1 (1.6)	
Impossible	0	0	
Overall intubation success rate through both devices (%)			
Success	55 (91.6)	58 (96.6)	0.43
Failure	5 (8.3)	2 (3.3)	
Number of attempts at intubation (%)			
One	45 (81.8)	39 (67.2)	0.11
Two	5 (9)	14 (24.1)	
Three	5 (9)	5 (8.6)	
Total successful attempts	55 (91.6)	58 (96.6)	
Ease of intubation (%)			
Easy	47 (85.4)	51 (87.9)	0.08
Moderate	4 (7.2)	7 (12)	
Difficult	4 (7.2)	0	
Time for intubation (sec) (mean±SD)†	20±15	15±5	0.00*
Total time (sec) (mean±SD)†	130±35	105±36	0.00*

*Statistically significant; †Median±interquartile range. SD – Standard deviation

endotracheal intubation in a trial with a success rate of 47% with CobraPLUS, 57% with Air-Q and 95% with Fastrach™[6] In all these studies PVC tube was used for intubation through Air-Q and silicone tube was used in ILMA which probably increased the success rates in latter. One recent study showed a good success rate of 94% (96.4% in ILMA) for intubation with Air-Q using the PVC tube in two attempts. Extension of the head and cricoid pressure was applied in this study.[10]

We found that the intubation time was more with ILMA group (20 s) compared with an Air-Q group (15 s). This was because more time was spent with ILMA in performing Chandy's manoeuvre whereas in Air-Q no such manoeuvre were required. The total time taken by the ILMA (130 s) was also greater as compared with Air-Q (105 s). This is because the ILMA needed manual inflation and deflation but Air-Q is a self-pressurising type of device with no time being spent in inflating/deflating the device cuff. Even the use of tongue depressor in Air-Q facilitated faster insertion. The time required for intubation and total time difference was statistically significant between the groups ($P = 0.00$). A similar study showed that intubation time with Air-Q was shorter (29.7 vs. 40.3 s) compared to ILMA.[10]

Intubation was easier in 85.4% cases in ILMA and 87.9% in Air-Q. Due to its hard and rigid PVC body, considerable friction was experienced during the passage of the ETT through the air-Q, even with adequate lubrication. In one study, intubation through ILMA and Air-Q was easier in 92.5% and 75% cases, respectively.[9]

Both the ILMA and Air-Q were successfully inserted in all the patients within three attempts. Even other studies have also demonstrated successful placement of the Air-Q in 100% cases within three attempts.[6,9] The airway tube of the LMA Fastrach™ is made of rigid metal, and often it is difficult to pass the device across the inter-incisor gap in patients with decreased mouth opening and prominent upper incisors. Because the shaft of the Air-Q is more flexible compared with rigid shaft of ILMA, ease of insertion is bit more with Air-Q (91.6%) but in ILMA group, it is 86.6%. Insertion was easy in 100% cases in ILMA and 95% cases in Air-Q in one study.[9]

Time taken for insertion of device was very less with Air-Q which was 15s but in ILMA group, it was 30 s (27 s and 13.3 s, 30 s and 19.6 s in other studies).[4,11] This difference was statistically significant ($P = 0.00$).

We compared haemodynamic stresss response between the devices [Figure 3] which showed MAP having a significant difference only at 2 min after intubation (more in ILMA group). There was no statistically significant haemodynamic stress response among the groups in a study by Randa *et al*.[10] In another study, haemodynamic stress response to intubation by Air-Q was less than that of direct laryngoscopy.[12]

The incidence of post-operative airway complications in this study was similar to other studies.[8,9,13] Grossly visible blood on device, after removal, was seen in one patient in each group(both of them required the third attempt for intubation) as compared with other study in which blood on the Air-Q (30/80) showed a statistically significant difference compared with ILMA (5/80).[9] Rigid tip of the PVC ETT used in Air-Q in the latter study may have often pushed against the anterior portion of the glottis and vocal cords, which led to an increased incidence of failed intubation and resultant trauma. Since soft reinforced tube was used in our study, such trauma was less. Even the use of self-pressurising Air-Q ILA decreases the airway morbidity. However, there was no difference in angle of emergence of both TTs in Air-Q [Figure 1].

Limitations of the present study were fibreoptic bronchoscope was not used in the study to assess the alignment of the device with the airway particularly in cases of failed intubation. Special silicone tube was not used in ILMA and also the second option of ETT was not kept with it during third attempt as in Air-Q. Ease of insertion and intubation measured were subjective and comparison made was for respective device and not between the devices and patients with difficult airways were not included in the study.

CONCLUSION

The present study shows that when intubation with reinforced tube fails, use of standard PVC tube does not produce statistically significant increase in success rate with Air-Q compared to LMA Fastrach™.

Acknowledgement

General support by Anaesthesia Department, PGIMER, Chandigarh.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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