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COMPARISON OF INTUBATION SUCCESS RATE USING AIRTRAQ LARYNGOSCOPE AND INTUBATING LARYNGEAL MASK AIRWAY IN NOVICE USERS WITH PRIOR AIRWAY MANAGEMENT EXPERIENCE: A PROSPECTIVE RANDOMISED STUDY

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Abstract

Background and Aims: *Securing the airway without morbidity is of prime importance. The difficult airway cart should have some advanced airway aids if not all. In this study we evaluated Airtraq laryngoscope and Intubating Laryngeal Mask Airway (ILMA) as intubating devices in novice users who were well accomplished in intubation using direct laryngoscope with Macintosh blade. Both the devices were used because of relatively lesser cost, portability and all in one compact design not requiring any setup.* ***Methods:*** *60 consenting American Society of Anaesthesiology (ASA) Grade I and II patients, weighing 50 to 70 were randomly assigned to be intubated by Airtraq or ILMA. Primary Aim was to compare success rate and intubation time. Comparison of ease of intubation and postoperative pharyngeal morbidity were the secondary end points.*
Results: *Success rate of intubation was higher in ILMA group (100%) than Airtraq (80%) [P = 0.0237]. However, in successful intubations the time for intubation was significantly less with Airtraq (Group A = 45.37 ± 27.55, Group I = 77.6 ± 31.85; P = 0.0003). No significant difference was noted in ease of intubation, number of optimizing manoeuvres to facilitate intubation and postoperative pharyngeal morbidity.*
Conclusion: *In Clinicians who are well versed with laryngoscopy using Macintosh blade but new to Airtraq and ILMA, success rate of intubation is higher with ILMA. Prolonged intubation time in ILMA should not deter its use in difficult airway scenarios because of the ability to ventilate through it.*

Keywords

Airway Management • Intubation • Laryngoscopes • Laryngeal masks

Introduction

Difficulties with tracheal intubation can affect patient safety. Securing the airway in a safe and timely manner is of prime importance. Failed or difficult intubation is associated with complications, including increased risk of hypertension, desaturation, unexpected admissions to the intensive care unit (ICU) and death [1,2]. Such difficulties during routine intubation occur in 1–6% of cases and failed intubation in 0.1-0.3% of cases but are much more common in ICU and the emergency department [3]. As compared to direct laryngoscopy, Videolaryngoscopy decreases intubation difficulty and may decrease failure rate particularly in context of difficult airway, although failed intubations using videolaryngoscope are reduced with experienced users but not with inexperienced users [4].

The Intubating Laryngeal Mask airway has proven to be a useful difficult airway device both within and outside of the operating room [5, 6, 7]. Effective ventilation is established in nearly all cases, and blind endotracheal intubation is possible in the vast majority of cases if the optimal techniques are used [8]. In a recent survey from India only 42% of the respondents had access to VL and 20% stated that it was only accessible to consultants, the major issue being cost [9].

The difficult airway cart should have some if not all of the advanced airway equipment. In this randomized study two such equipment namely Airtraq™ Laryngoscope [King Systems Corporation, Noblesville, IN 46060] and Intubating Laryngeal Mask Airway [LMA Fastrach™] using polyvinyl chloride (PVC) Endotracheal tube (ETT) were compared. Primary Aim was to compare success

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rate and intubation time. Comparison of ease of intubation and postoperative pharyngeal morbidity were the secondary end points. The above equipment were used because of their relatively lesser cost, portability, all in one compact design not requiring any set up, hence can be easily used outside the operating room, in rural areas and by the freelancing anaesthesiologist.

Subjects and Methods

Following approval from the institutional ethical committee, 60 consenting American Society of Anaesthesiology (ASA) Grade I and II patients of either sex, aged between 18 and 65 years, weighing 50 to 70 kg, posted for elective surgery under general anaesthesia were included. Patients with Any pathology of the oral cavity that could obstruct the insertion of device, mouth opening less than 18 mm and cervical spine injury were excluded. (Figure 1)

After taking informed consent, they were randomly divided into two groups of thirty patients each using a computer-based random number generator to be intubated using AirTraq® size-3 laryngoscope or ILMA size 4. The intubations were performed by anaesthesiology residents in second year of training who were well trained in intubation and laryngoscopy using Macintosh blade but were new to use of both devices. The learning curve was achieved by the by performing 10 intubations per device in manikin. The intubations were done in the presence of a senior anaesthesiologist with good experience in the use of both devices. Anaesthetic technique was standardised for all patients. PVC ETT of size 7 mm internal diameter (ID) for females and size 7.5 mm ID for males was used in all patients of either group. Tracheal intubation was considered successful if the patient was intubated in one or two attempts and less than 120 seconds.

For the Airtraq (A)group, the head was placed in the neutral position, The standard technique consisting of sliding the tip of the Airtraq laryngoscope into the mouth along the tongue was

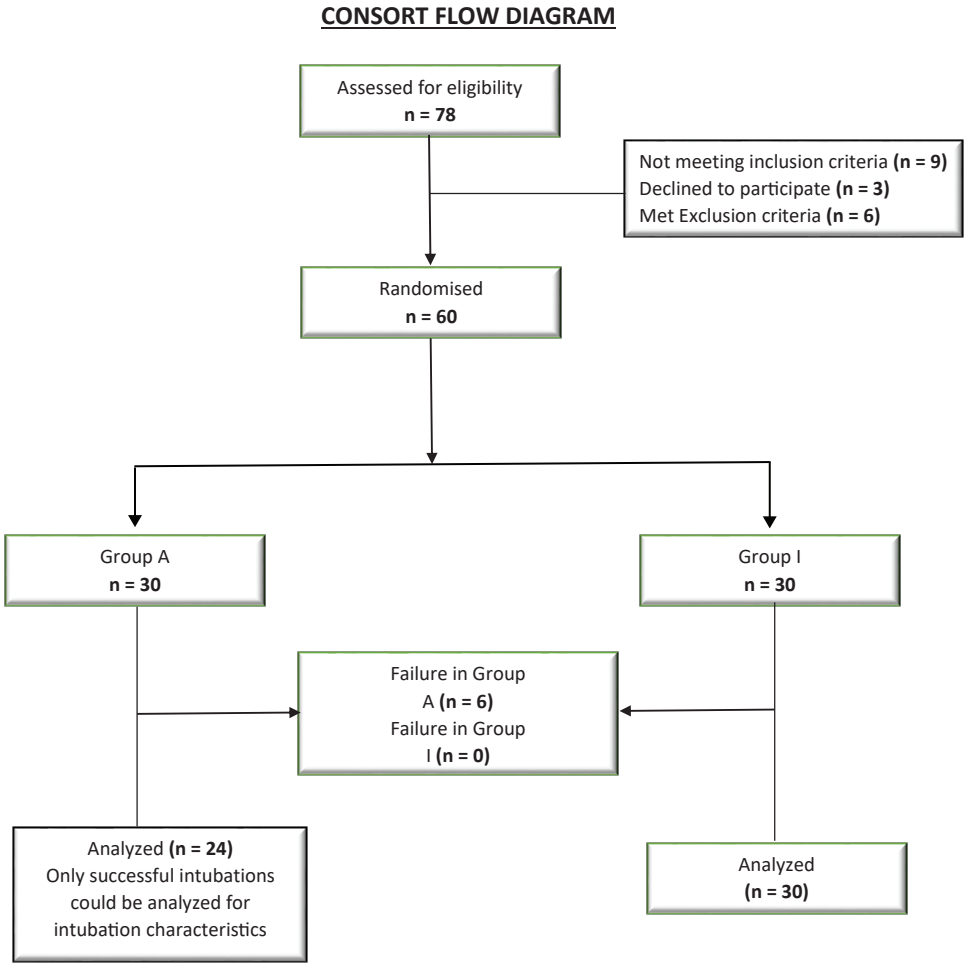

Figure 1. CONSORT Flow diagram.

used. If passage of the laryngoscope into the oropharynx was difficult crawling movements were used to move the blade over the tongue towards the epiglottis [10]. If the glottic opening was not visible the laryngoscope was withdrawn and further pulled up to lift the epiglottis, and other adjusting manoeuvres like readjustment of head position, external laryngeal manipulation and /or a bougie were used as the need arose.

For the ILMA (I) group the mouth was opened as wide as possible and the ILMA was gradually introduced into position with a one-handed rotational movement using the steel handle. The cuff of the ILMA was inflated with air (30 ml for size 4 ILMA) as mentioned in the product manual and ability to ventilate was confirmed by square wave capnograph trace and bilateral equal chest movements. If any one of the criteria for satisfactory ventilation were not met, the ILMA was manipulated *in situ* by using the first step of the Chandy manoeuvre; this consists of rotating the device in the sagittal plane until the least resistance to bag ventilation was achieved [11]. Intubation was attempted only when ventilation was possible through the device. Manoeuvres tried for tracheal placement of the tube during an attempt were twisting of the tracheal tube to align the bevel; up-and-down movement of the tracheal tube and repositioning the ILMA with the metal handle, by slightly lifting but not tilting the ILMA away from the posterior pharyngeal wall, which is the second step of the Chandy manoeuvre [11]. Persistence of tactile resistance even after performing the Chandy manoeuvre was counted as a failed attempt.

In both the groups, each attempt at intubation was timed. In group A the time from beginning of insertion of the device to the confirmation of intubation by capnography. In the ILMA group the total time **(T)** taken was split into three parts: Time taken to insert the ILMA **(T1)** –recorded as time from beginning of insertion to confirmation of ventilation by capnograph, Time taken to intubate through the ILMA **(T2)** –from beginning of intubation to confirmation of correct tube placement with capnograph and Time taken to remove the ILMA **(T3).**

If intubation was unsuccessful in the first attempt, each of the further attempts excluding the period of interposed ventilation was timed separately. The total time of intubation(s) was taken as the sum of the time taken at each attempt at intubation until intubation was achieved. Number of attempts for successful intubation were recorded. If intubation was not achieved within 120 seconds excluding the period of interposed ventilation, it was considered unsuccessful. A senior anaesthesiologist would then intubate the patient or insert a classic Laryngeal mask airway (LMA). In successful intubations ease of intubation was graded by the clinician using Visual analogue scale VAS [Grade 0 being difficult to 10 being very easy] [10]. The initial Mallampati grading recorded during Pre-anaesthetic Assessment was correlated to the incidence of successful intubation. Any trauma during intubation was assessed by presence of blood on the ETT after extubation. Incidence of Sore Throat was graded as in (Table 1) [12].

Size was determined to detect a difference of 15 % in success rate between the two devices. It was determined from a previous study to be 30 in each group [12,13], allowing an alpha-error of 0.05 and a beta-error of 0.2 (power of 80%). Results are presented in number, percentage, mean and SD as appropriate. Continuous data were compared using student's t-test, categorical data using Fisher exact test and Chi-square ($\chi 2$) test. A probability value $P < 0.05$ was considered statistically significant.

Results

The demographic variables were comparable in both groups (Table 2). In group A 24 out of 30 intubations were successful while in group I all 30 intubations were successful (p = 0.0237). Intubation characteristics of successful intubations are described in Table 3. In successful intubations, total time taken to intubate (T) was much less in group A (45.37±27.55) than group

Table 1: Grading of sorethroat

Score	Description
0	No complaints or evidence of sore throat or hoarseness
1	Patient complaints of minimal sore throat but observer found no hoarseness when compared with preoperative quality of voice
2	Patient complaints of moderate sore throat or observer found moderate hoarseness
3	Patient complaints of severe sore throat or observer found marked hoarseness.

Table 2: Comparison of demographic variables in both groups

Patient characteristics	Group A	Group I	P value
female: male	12:17	11:18	1.00
Age (years)	35.26 ± 11	35.5 ± 11	0.93
Weight (Kg)	57.23 ± 7.61	59 ± 6.91	0.35
ASA I/ II [n]	24/6	23/7	1.00
MP I/II/III/IV [n]	16/10/4/0	11/12/5/2	0.35

Data is presented as numbers (n) and mean ±SD; ASA- American society of anaesthesiologists; MP-Mallampati

I (77.6±31.85) [P = 0.0003]. ILMA being a supraglottic device would take more time to intubate than a videolaryngoscope hence the total time taken to intubate (T) in the Airtraq group was compared to time taken to intubate through ILMA (T2) excluding ILMA insertion and removal time. When T in group A was compared to T2 in group I, time taken to intubate through ILMA was less than Airtraq. In ILMA group Mean (SD) T1, T2, T3 were 23.53(12.64), 33.06(19.07), 33.2(13.16). In most patients in group I it was seen that maximum time was taken to remove the ILMA (T3). There were no significant differences between the ease of intubation, number of attempts needed for successful intubation and number of adjusting maneuvers in both the groups. Success rate of intubation did not differ in different MP grades. On comparing ease of intubation to the MP grade separately in both the groups, no significant difference was found as regards to ease in different MP grades. No oesophageal intubation occurred in any group. Postoperative pharyngeal morbidity assessed in the form of blood staining on ETT occurred in six patients in each group. In group A one patient had sore throat (grade 1) and in group I two patients had sore throat, one had grade 1 and the other had grade 2.

Discussion

In the Airtraq group all Clinicians could visualize the glottis in a short span of time but only 21 could intubate in the first attempt, the difficulty on attempting intubation was that the tube went posteriorly behind the glottis or it hit the arytenoids. Reason behind this could be that clinicians were already trained in conventional laryngoscopy for which direct line of sight needs to be achieved from the physician's eyes to the larynx, have their hand eye co-ordination set accordingly. While in Airtraq the exaggerated distal curvature of the blade (which is more than the Macintosh laryngoscope) and the presence of prisms help us to visualize a glottis which is in fact lying a lot anterior but the ETT cannot always negotiate such a curvature. This difficulty with Airtraq was overcome by withdrawing it slightly so that it was not as close to the vocal cords, lifting it upwards and again intubating resulted in successful intubation. By withdrawing slightly, the ETT had additional distance to travel and the curve of the ETT brought the tip anteriorly, facilitating its passage through the glottis. Fogging did occur which blurred the view of vocal cords and hindered intubation, this problem was overcome by attaching the breathing circuit to the ETT preloaded on to the guide channel and a single emergency oxygen flush cleared the fogging.

In the ILMA group ventilation was possible in all patients but one, the reason for failed ventilation being improperly sized ILMA. In all patients who could be ventilated, intubation was also possible. In 26 patients it was possible in the first attempt. Since view of the glottis was not needed to facilitate intubation, the hand eye coordination did not play a role in intubation through the ILMA. That may be one reason of higher success rate of ILMA than Airtraq in our study.

In some patients a tactile resistance to the passage of the tube was felt, the second part of the Chandy maneuver was tried, Use of the Chandy maneuver can be expected to improve first-time intubation rates with the ILMA to levels approaching 100% [14]. The incidence of multiple intubations is significantly lower when the Chandy maneuver is used before intubation [14].

PVC tubes are economical, disposable and easily available and since we wanted to use similar tubes in both groups, PVC tubes were chosen though this could be the reason for slight difficulty during intubation through ILMA. Methods used to increase the ease of passage of PVC ETT through the ILMA were liberal lubrication of the tube with its inflation line and pilot balloon with water soluble jelly and prewarming of the tube to a temperature of approximately 40º C. Our results with the PVC ETT were good as proved in previous studies [15,16]. As shown in Figure 2, the inflation line of the ETT with the blue pilot balloon was easier to pass through the shaft of the ILMA than the inflation line of the ETT with the transparent pilot balloon, due to difference in their shape.

Three patients in the ILMA group developed right sided bronchospasm, as diagnosed by rhonchi on auscultation post intubation which resolved on its own. Desaturation did not take place in any patient. The reason for the above was same, too deep insertion of the ETT for fear of extubation while removal of the ILMA, which also explains only the right sided bronchospasm in all the three patients.

Table 3: Comparison of Intubation Characteristics in successful intubations between both groups

Parameters	A (n = 24)	I (n = 30)	P value
T in seconds (mean ±SD)	45.37 ± 27.55	77.6 ± 31.85	0.0003
T in A, T2 in I (mean±SD)	45.37 ± 27.55	33.06 ± 19.07	0.058
Ease of intubation (VAS median [IQR])	5 [4-6]	5 [4-7]	0.533
Number of attempts (1/2)	19/5	26/4	0.489
Number of adjusting maneuvers (0/1/2)	11/12/1	13/15/2	0.91

Data is presented as mean±SD, median [IQR] and numbers. T- Total intubation time, T2- Time of intubation through the Intubating laryngeal mask airway, VAS- Visual analogue score, IQR- Interquartile range

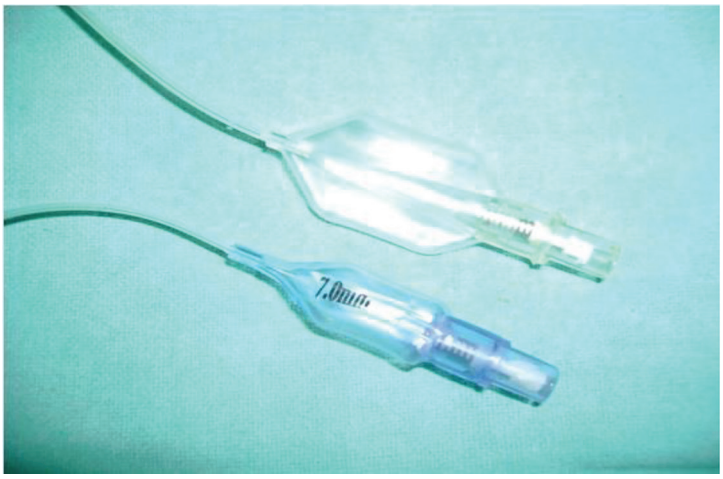

Figure 2. Different shapes of pilot balloon.

There is paucity of data comparing ILMA to Airtraq in real patients by clinicians with prior airway management experience though new to these two devices.

With no prior airway management experience both Airtraq and ILMA demonstrate advantage over Macintosh [10,17] though Macintosh outperformed Airtraq when used by second year postgraduate residents of anaesthesia [18] probably because the learning curve for direct laryngoscopy had already been achieved but not so for Airtraq. Their mean intubation time through Airtraq was similar to ours (40 to 45 seconds) though in experienced hands it is usually under 20 seconds [19, 20]. In successful intubations Time taken to intubate through Airtraq was significantly less than ILMA in our study similar to another study done in obese patients though Intubation attempts and number of optimisation maneuvers were similar in both groups, comparable to ours [21].

In the context of manual in line stabilization, when intubations were done by experienced anaesthesiologist, Videolaryngoscopes outperformed ILMA. CMAC group had higher intubation success rate and significantly shorter intubation time, though ILMA group had a significantly shorter apnea time [13]. In another study Bullard Laryngoscope provided a higher success rate than the ILMA, though the difference was not significant, Intubation time through ILMA was similar to ours [12].

In out of hospital difficult to manage airways, emergency physicians were able to ventilate and intubate all patients with ILMA [22]. In vehicle entrapped patient simulation, ILMA proved most effective intubation device by paramedics [5]. Even With limited intubation skills all were able to ventilate through the ILMA and reported it easy to use [7]. After Failure of direct laryngoscopy,successful intubation was possible in 91% by ILMA by emergency physicians trained in its use on Mannequins [6]. The success rate of blind intubation through ILMA has been reported to be more than 90 % in a recent review [23].

Comparison of six videolaryngoscopes in 720 patients with simulated difficult airway by Airway management experts confident with the use of each device , found marked difference between the six videolaryngoscopes , first attempt success rate ranging from 85 to 98 %. Highest was with McGrath™ and C-MAC™ D-blade highlighting the importance of the Macintosh blade design. Overall success rate with Airtraq was 93% with first attempt success rate being 85% was much higher than ours. The incidence of Mucosal injury with Airtraq was 10% which was less than ours (20%) reflecting the difference in expertise of the user. Success rate with A.P. Advance™ was only 40% questioning the data from manikin studies [24].

Differences in ease of intubation and adjusting maneuvers were difficult to compare between studies, due to the difference in type of tracheal tube used, whether study was on simulators or real patients, intubations done by novices or by people with prior airway management experience.

Limitations in the present study were blinding the anaesthesiologist to the device was not possible, hence there could be some element of bias. Since most patients recruited had easy airway, therefore the advantage of these devices in actually difficult scenarios could not be assessed. Grading of ease of intubation was subjective.

Conclusion

ILMA is a very effective device for intubations in varied scenarios even with limited training. We found ILMA better than Airtraq in clinician well versed with direct Laryngoscopy but new to the two devices in this study. Since familiarity with the working devices on the difficult Airway cart is very crucial, ILMA and Airtraq should be incorporated in training of airway management.

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