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Comparison of tracheal intubation with the Macintosh or the Airtraq Laryngoscope in simulated difficult laryngoscopy using rigid neck collar: a randomized, controlled clinical trial

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ABSTRACT

Background and Aims: Airtraq laryngoscope provides view of glottis without alignment of oral, pharyngeal and laryngeal axis. We decided to compare safety and efficacy of Macintosh and Airtraq laryngoscope in simulated difficult laryngoscopy using rigid neck collar. **Methods:** It was a prospective, randomized, controlled clinical trial conducted in a tertiary care teaching hospital. Patients with American Society of Anesthesiologist (ASA) physical status I and II, age 18 to 60 years and scheduled recruited for elective surgery requiring general anesthesia with oral endotracheal intubation were included. The patients were divided into Macintosh and Airtraq groups comprising of 40 patients each. Difficult laryngoscopy was simulated using rigid neck collar. Macintosh and Airtraq laryngoscope was used respectively. The primary outcome measure was time of intubation. The secondary outcome measures were: number of attempts, ease of intubation, overall success rate, modified Intubation Difficulty Score, Percentage of Glottic Opening score, hemodynamic parameters and complications. **Results:** The time of intubation was significantly low for Airtraq (27.80 sec) compared to Macintosh laryngoscopes (p = 0.04). Number of successful first intubation attempt was significantly higher in the Airtraq group though the overall success rate was similar in the two groups. The median visual rating scale of the ease of intubation and the mean Intubation Difficulty Score were significantly lower and the median POGO score was also significantly improved in the Airtraq group. **Conclusions:** The Airtraq optical laryngoscope allowed a shorter intubation time, fewer intubation attempts, and greater ease of intubation compared with the Macintosh laryngoscope.

Key words: Airtraq laryngoscope, difficult laryngoscopy, intubation

INTRODUCTION

Restricted neck movement poses a significant difficulty in intubation because of non-alignment of oral, pharyngeal and laryngeal axes. Application of cervical collars may reduce cervical spine movements, but it also reduces the mouth opening, rendering laryngoscopy difficult[1]. Besides, the neck collar lifts up the chin and tips the larynx anterior

The unique curving blade of the Airtraq optical laryngoscope (Prodol Meditec S.A. , Vizcaya , Spain) which is designed to fit the oropharyngeal anatomy and an internal arrangement of the optical components provided a view of glottis without alignment of oral, pharyngeal and laryngeal axis. It possesses considerable advantages in the setting of cervical spine immobilization[3]. The Airtraq facilitates tracheal intubation with the neck in neutral position, which is similar to the neck position maintained by a rigid cervical collar[4].

In this present study, we compared Airtraq optical laryngoscope with conventional Macintosh laryngoscope,

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hypothesizing that tracheal intubation would be easier with Airtraq laryngoscope compared to Macintosh in simulated difficult laryngoscopy due to rigid neck collar.

MATERIALS AND METHODS

With the approval of Institutional Ethical Committee, and well informed written consent for this prospective, randomized, double blind study, we enrolled 80patients. This study was conducted according to Good Clinical Practice standards and the Helsinki Declaration, and the protocol was registered at ClinicalTrial.gov (NCT02387502). Our study followed the CONSORT recommendations.

Eligibility criteria for the patients were: American Society of Anesthesiologist(ASA) physical status I and II, age 18 to 60 years and scheduled recruited for elective surgery requiring general anesthesia with oral endotracheal intubation. The exclusion criteria included patients with anticipated difficult airway, obese (body mass index [BMI] >30) patients, patients with risk of pulmonary aspiration of gastric contents, pregnant patients and patients with airway distortion or trauma. Data were collected in the operating room and post-anesthesia care unit of a tertiary care teaching hospital.

The patients were divided into two groups comprising of 40 patients each in which Macintosh and Airtraq laryngoscope was used respectively. Block randomization was done on computer-generated codes sealed in sequentially numbered opaque envelopes. An anesthesiologist, not involved in the intubation procedure, generated random allocation sequence, enrolled participants and assigned patients to intervention. Patients and outcome assessors were blinded to the study. After pre-anesthetic evaluation, an appropriate sized rigid cervical collar (Ambulance, MGRM Medicare Limited, Hyderabad, India) placed as per manufacturer's instructions. Mouth opening was measured before and after its application. Standard monitoring including ECG, noninvasive arterial pressure, SpO_2, and measurement of end-tidal carbon dioxide were used. Patients were premedicated through intravenous route with inj. Dexamethasone 4 mg, inj. Midazolam 0.05mg/kg, inj. Fentanyl 2 µg/kg and inj. Glycopyrrolate 0.01mg/kg following which preoxygenation was done with 100% oxygen for 3 minutes. Anaesthesia was induced with inj. Propofol 2mg/kg i.v. and relaxation was done with inj. Rocuronium 0.6 mg/kg i.v. An anesthesiologist (BD), having experience of more than 75 intubations with Macintosh laryngoscope and more than 50 intubations with Airtraq laryngoscope did the laryngoscopy in all patients. Intubation was done with a 7.0-mm cuffed tracheal tube in females and an 8.0-mm cuffed tracheal tube in males.

For patients allocated to intubation with the Airtraq, the device was inserted into the mouth and positioned with the glottis seen at the center of the eyepiece. The endotracheal tube was the inserted into the mouth and the scope was detached and removed from the mouth. Finally, the respiratory circuit was connected and placement of the tube was confirmed with square wave capnography[5]. If introduction of the intubating device was not possible or there were more than three attempts for intubation or intubation time will be more than 120sec, it was considered to be a failure. In case of failure to intubate, cervical collar was then removed and intubation was proceeded. Failure to intubate (>3 attempts or >120sec) and episodes of desaturation (SpO_2<90%) during intubation was documented.

The primary outcome measure was time of intubation which was defined as time from passing the device beyond the incisors and confirmation of tube placement by square wave capnograph tracings. The secondary outcome measures were: number of attempts, ease of intubation (in Visual Rating Scale from 0-10; 0=easiest and 10=most difficult), overall success rate, modified Intubation Difficulty Score (IDS)[6] (Annexure 1), Percentage of Glottic Opening (POGO) score, hemodynamic parameters (heart rate and mean arterial pressure in pre-induction and the interval of 1, 3 and 5 minutes post-intubation) and airway trauma.

In a previous study[5], the mean (SD) intubation time with the Airtraq with restricted neck movement is 28.73 (6.39) sec. Assuming that the 25% difference in mean between the Airtraq and Macintosh group, we calculated that 40 patients in each group is required to provide 90% power with a two-tailed alpha of 0.05. So, we kept the sample size of 80 patients with 1:1 allocation ratio.

The frequency of intubation complications, the overall intubation success rate and esophageal intubations were assessed by the chi square test. Continuous data were compared using student t test. Statistical analysis was performed using SPSS software (version 19.0; SPSS Inc., Chicago, IL, USA). A p value < 0.05 was considered significant.

RESULTS

Total 80 patients were analysed keeping 40 patients in each group. Two groups were comparable in baseline demographic and airway assessment characteristics [Table 1]. The time of intubation was significantly less for Airtraq (27.80 sec) compared to Macintosh laryngoscopes (p = 0.04). Number of successful first intubation attempt was

significantly higher in the Airtraq group though the overall success rate was similar in the two groups [Table 2]. The median VRS of the ease of intubation was significantly lower in the Airtraq group [Figure 1]. The median POGO score was also significantly improved in the Airtraq group. The mean Intubation Difficulty Score was also reduced significantly in Airtraq group. Pulse rate was significantly lower in Airtraq group at 1 min and 3 min after intubation [Figure 2]. Mean arterial BP was lower at 1 min after intubation in Airtraq group [Figure 3].

There were no differences in complications [Table 2].

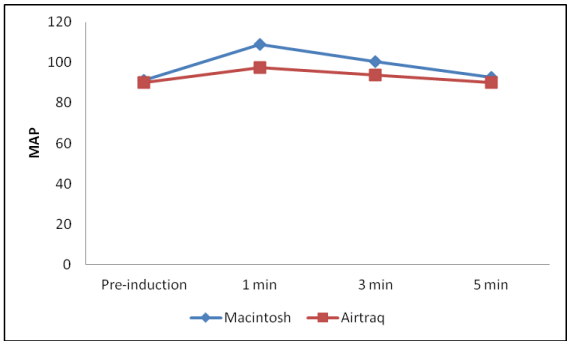


Figure 1. Comparison of pulse rate between the two groups up to 5 minutes after intubation. Pulse rate was significantly low at 1 min and 3 minutes after intubation in the Airtraq group. Values are in mean and standard deviation. *Statistically significant, *P<0.05.*

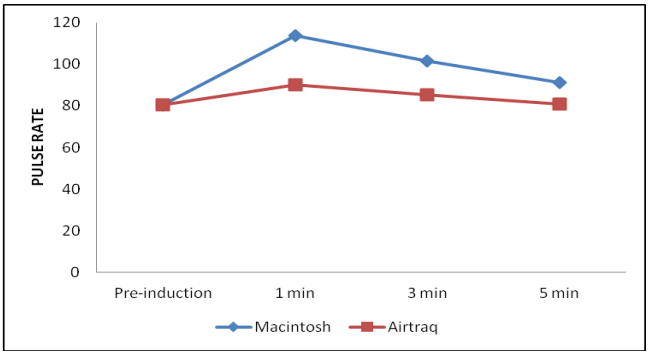


Figure 2. Comparison of mean arterial pressure between the two groups up to 5 minutes after intubation. Mean arterial pressure was significantly low at 1 minute after intubation in the Airtraq group. Values are in mean and standard deviation. *Statistically significant, *P<0.05.*

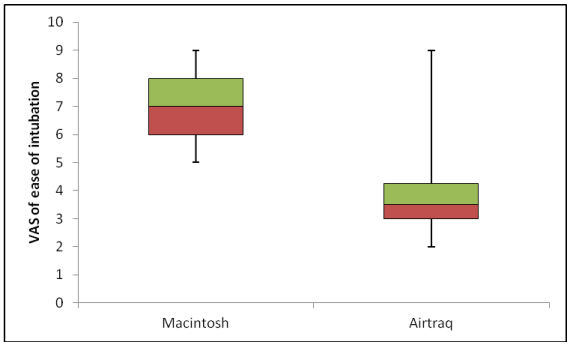


Figure 3. Box plot representing Visual Analogue Score (VAS) ease of intubation with the two devices. VAS score was significantly lower with the Airtraq group compared with other group. Values are in median, inter-quartile range, maximum and minimum. *Statistically significant, *P<0.001.*

Table 1: Showing a comparison of the incidence of difficult intubation in children with hydrocephaulus with the normal paediatric population

Parameters	Macintosh group (*n*=40)	Airtraq group (*n*=40)	P value
Age (years)	39.35 (9.92)	35.47 (10.10)	0.17
Sex (M:F)	14 : 26	15 : 25	0.97
Weight (kg)	58.65 (6.03)	57.62 (5.65)	0.69
Body mass index (kg/m^2)	22.41 (1.11)	22.03 (1.13)	0.98
ASA physical status (median)	1	1	
Mallampati grade	2 (1-2)	1 (1-2)	0.30
Thyromental distance (cm)	6.19 (0.40)	6.28 (0.44)	0.36

Table 2: Showing a comparison of the incidence of difficult intubation in children with hydrocephaulus with the normal paediatric population

Parameters	Macintosh group (*n*=40)	Airtraq group (*n*=40)	P value
Intubation attempts (1/2/3)	14/17/9	30/8/2	0.0001*
Overall success rate (%)	85	97.5	0.16
Time of intubation (sec)	41.22 (4.72)	27.80 (3.87)	0.04*
Ease of intubation (VRS)	7 (6-8)	3.5 (3-4.75)	0.0001*
POGO†	35 (20-40)	70 (65-85)	0.0001*
IDS‡	4.20 (1.52)	1.22 (0.42)	0.04 *
Esophageal intubation	6	1	0.16
Complications Blood on laryngoscope blade	3	2	
Minor laceration	0	5	
Dental or other airway trauma	0	1	0.29

P=statistically significant. †= percentage of glottis opening. ‡=intubation difficulty score.*

DISCUSSION

In this study we compared Airtraq optical laryngoscope with Macintosh laryngoscope in difficult laryngoscopy situation using a rigid neck collar in patients undergoing elective surgeries requiring general anaesthesia and tracheal intubation. Rigid neck collar not only prevents alignment of oral, pharyngeal and laryngeal axes, but also it limits mouth opening, rendering normal airway difficult. We found that intubation was easier and less time was required with Airtraq with similar complication rate compared to Macintosh laryngoscope.

The primary outcome measure was time of intubation. The intubation time was 14 seconds longer in Macintosh group than Airtraq group. This finding is consistent with the finding of the study by Tolon et al[6]. They found the intubation time was 48 seconds and 34 seconds with Macintosh and Airtraq laryngoscope respectively with manual in line stabilisation. Ali et al.[5] reported that intubation was 11 seconds shorter with Airtraq compared to MacCoy laryngoscope in patients with rigid neck collar (28 s vs 39 s). In our study, the shorter intubation time with Airtraq may be explained due to two reasons. First, more patients were intubated in the first attempt with Airtraq which reduced the total time. Higher number of second and third attempts in Macintosh group increased the duration of intubation. Second, the improved glottic viewing with the Airtraq helped the laryngoscopist to pass the tracheal tube in shorter time compared to Macintosh.

30 out of 40 patients were intubated in the first attempt with the Airtraq, whereas, 14 patients were intubated in the first attempt with Macintosh. There are conflicting reports in previous studies regarding the number of attempts comparing Airtraq and Macintosh laryngoscope in cervical spine stabilisation. Maharaj et al.[7] reported no significant difference between Airtraq and Macintosh, while number of successful 1st attempt was significantly increased in the study of Durga et al[8]. According to Ali et al.[5], there was no difference in the number of first attempt between Airtraq and MacCoy. We felt that keeping the vocal cord in the centre of the eyepiece of the Airtraq and keeping the tip of the Airtraq blade slightly away from the vocal cord increased the probability of successful intubation. On the other hand, improper visualization of the glottic opening and suboptimal space in the oral cavity to negotiate the tube were the probable causes of higher number of subsequent attempts with Macintosh. The overall success rate of our study was similar to other studies[9,10].

In our study Airtraq was associated with significantly less intubation difficulty, more ease of intubation and better visualization of glottic opening. These findings are consistent with the other studies[11-13]. Higher POGO score, less IDS and more ease of intubation with Airtraq were probably due to the structural difference from Macintosh blades. Enhanced curvature and reflection of image through multiple lenses and prisms in Airtraq are responsible for the better view of the vocal cord whereas, the side channel for loading of the tracheal tube makes it easier to negotiate the tube after visualization of the vocal cord. In Macintosh blade, proper visualization of glottic opening requires alignment of oral, pharyngeal and laryngeal axes which was not possible with rigid neck collar. Furthermore, less space inside the oral cavity renders the insertion of tracheal tube difficult. Esophageal intubations were more with Macintosh group but those were not statistically significant.

Hemodynamic response to laryngoscopy and intubation was least with Airtraq. Pulse rate and mean arterial pressure remained significantly less up to 3 minutes and 1 minute after intubation in Airtraq group. Das et al. also reported Airtraq imparted less hemodynamic response compared to Macintosh laryngoscope in non-ophthalmic surgeries[14]. The possible explanation might be that the Airtraq imparts less force to align the oro-pharyngeal-laryngeal axes for intubation; e. g. the traction force to lift the epiglottis is reduced and hence causes less pain-mediated release of the catecholamines[15-18].

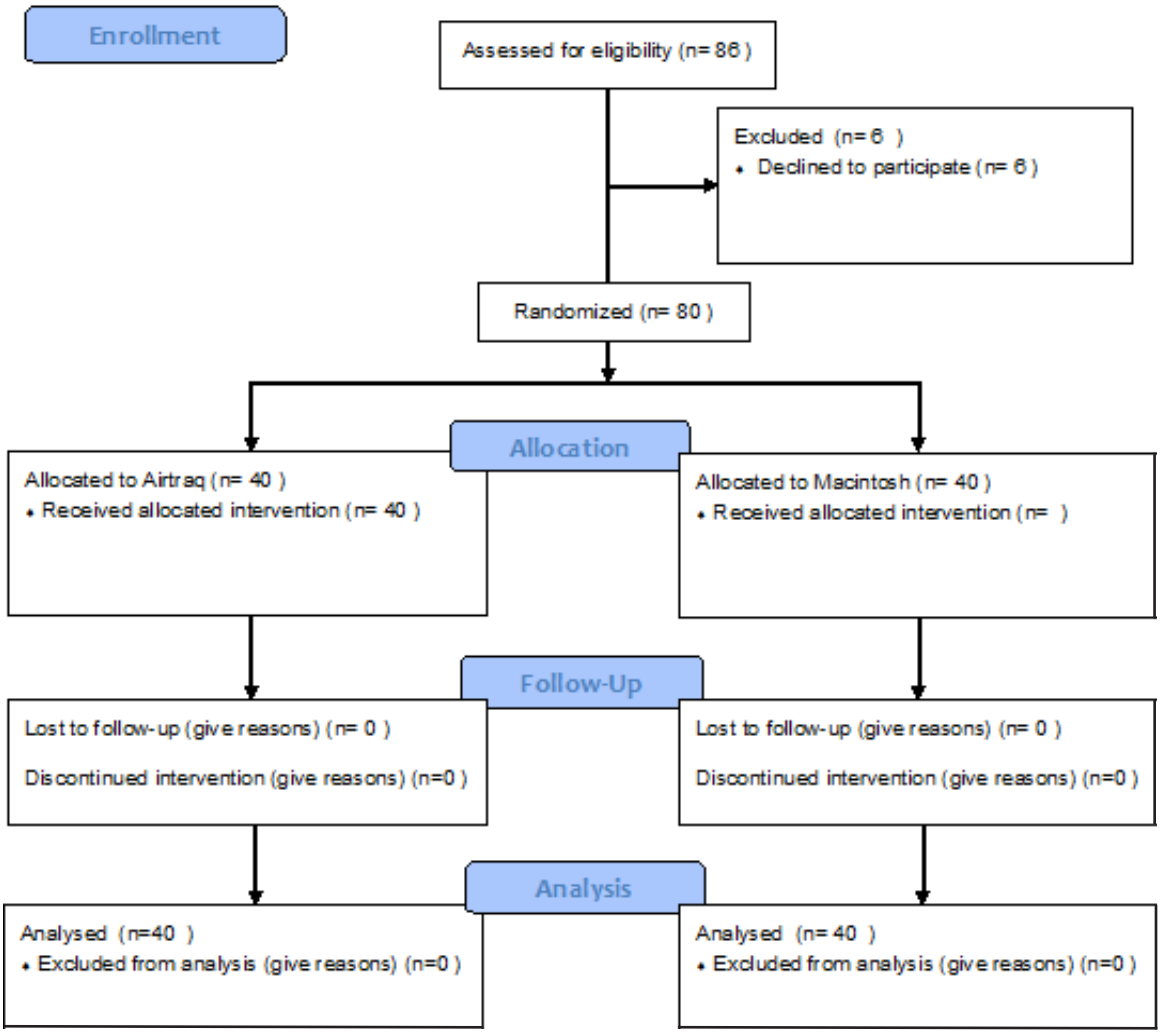
Complications like airway trauma and tongue-lip-dental injuries were more with Airtraq but those were statistically not significant. Relative bulkiness of the Airtraq blade compared to other two laryngoscopes caused the injuries near tongue, lips and teeth. But the increased lifting force with Macintosh blade inflicted more injuries near the vallecula and epiglottis. So, the incidence of blood staining on laryngoscope blade was more with Macintosh blade[19-22].

There are certain limitations to this study. First, the intubating anaesthetist was not blind to the randomization of the laryngoscope. This could have led to bias if the anaesthetist already had a preference to the device. However, the primary outcome, time of intubation, and most of the secondary outcomes were well defined and objective. Second, POGO score was used to assess the visualization of the vocal cord. POGO is used to visualize vocal cord during direct laryngoscopy but because of lack

of any universal scoring system, POGO score was used. POGO score was chosen instead of modified Cormack-Lehane because the POGO score can distinguish patients with large and small degrees of partial glottic visibility, it might provide a better outcome for assessing the difference between various intubation techniques[23].

In conclusions, the Airtraq laryngoscope, as compared to McIntosh, significantly reduces the mean time of intubation, offers better laryngeal view, has higher success rate at first intubation attempt, reduces the IDS, has least effect on hemodynamic parameters and causes less airway trauma in simulated difficult laryngoscopy using rigid neck collar. The Airtraq thus appears preferable to Macintosh laryngoscope simulated difficult laryngoscopy using rigid neck collar.

CONSORT 2010 Flow Diagram



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ANNEXURE 1

Intubation difficulty scale

Parameter	Score
Number of attempts >1	N1
Number of operators >1	N2
Number of alternative techniques	N3
Cormack grade-1	N4
Lifting force required Normal Increased	 N5=0 N5=1
Laryngeal pressure Not applied Applied	 N6=0 N6=1
Vocal cord mobility Abduction Adduction	 N7=0 N7=1
Total score: IDS=sum of scores	**N1–N7**