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Comparison of the Airtraq video laryngoscope versus Macintosh laryngoscope for tracheal intubation in the pediatric patients: A prospective randomized controlled trial

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***Abstract*---**Securing a patent airway in patients undergoing general anesthesia is routinely done using gold standard methods of direct laryngoscopy with a Macintosh or Miller laryngoscope blade in children. However, this technique has several limitations. Video laryngoscopes provide the user with a better view of the larynx. We undertook this prospective, randomized, controlled trial to determine the intubation time of Airtraq compared with Macintosh laryngoscope in pediatric patients, number of intubation attempts, quality of visualization, optimization maneuvers, easiness of intubation, and cardiovascular changes during intubation. A total of 80 pediatric patients of either sex, between ages three to twelve years, belonging to

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American Society of Anesthesiologists (ASA) status I and II, who were divided equally into two groups using the sealed envelope technique. Patients were randomly assigned to be intubated with either Airtraq (Group A) or Macintosh laryngoscope (Group M). The difference between the time required for intubation within the two groups was significant ($p < 0.05$), optimization maneuvers were more required for Group M than Group A ($p < 0.01$). Quality of visualization was better in Group A compared with patients in Group M ($p < 0.05$). It shows that three min after intubation, mean pulse rate and mean blood pressure changes were statistically significant within the two groups ($p < 0.05$). Statistically lesser time was required for intubation, better visualization of glottis and more hemodynamic stability with Airtraq video laryngoscope compared to the Macintosh laryngoscope.

***Keywords*---**stress response, position, airway, intubation, children, video laryngoscope.

Introduction

Airtraq (Prodol Meditec, Vizcaya, Spain), is a cost-effective video laryngoscope successfully employed in many difficult airways in the pediatric population.[1,2] Its exaggerated curvature of the blade and optical arrangement gives a good view of the glottis without aligning oral, pharyngeal, and laryngeal axes when compared with Macintosh laryngoscope.[3] It's quite evident from the medical literature that video laryngoscopy is gaining popularity as an airway device for pediatric patients.[4,5] Some anesthesiologists have included the utilization of video laryngoscopy into their usual airway management of the pediatric patient and for others, video laryngoscopy could also be reserved for a difficult pediatric airway.[6,7] The impact of video laryngoscopy in airway management is significant and continues to grow.[8,9] The changes have affected the perioperative management of paediatric patients. [10, 11, 12] Though there are less studies on paediatric patients as compared to adult patients in regard to this subject, so a review of these advances is warranted.[13] This randomised controlled study was designed with the aim to determine the intubation time of Airtraq compared with Macintosh laryngoscope in paediatric patients, number of intubation attempts, quality of visualization, optimization manoeuvres, easiness of intubation, and cardiovascular changes throughout intubation. Compared with Macintosh laryngoscope, we hypothesize that pediatric Airtraq video laryngoscope will be easy to use.

Methods

This prospective randomized controlled trial study was carried out in the department of Anesthesiology from March 2018 to February 2019 which was done by using parallel simple random probability sampling with an allocation ratio of 1:1 by a third independent party. A total of 80 pediatric patients of either sex, among ages three to twelve years, belonging to ASA status I and II and Mallampatti grade I & II who were scheduled for elective surgical procedures under general anesthesia were taken for the study with exclusion criteria of sore

throat, upper respiratory tract infection, the patient suffering from any respiratory disease that might cause airway narrowing, pre-existing laryngeal or tracheal pathology, any lesion that could cause airway deformity due to fibrosis, anticipated difficult airway, limited neck extension, anatomical abnormality of the airway, patient not willing for participation. We visited the patients on the previous day of the surgery. All the data collection were done at our tertiary hospital setting. A detailed medical history was taken.

General examination, physical examination, systemic examination and thorough airway assessment were carried out. Patients' weight was noted. All the patients were investigated for all the routine and special investigations. Patients were explained in detail about the reason, process of the study and probable side effects. They were shown the letter of information on the study. They were explained about the procedure and devices. These procedureswere followed in accordance with the ethical standards of the institutional committee on human experimentation. After that, written informed consent was taken. Patients were kept nil by mouth 6-8 h before the surgery. Primary parameters of outcomes included 1) Intubation time: The time from first picking up the laryngoscope until the first capnography upstroke following intubation (considering only successful attempt). 2) Number of attempts for intubation: Attempts for intubation would be done a maximum of two times. More than two attempts were counted as a failure. 3) Quality of visualization of glottic aperture. Quality of visualization was assessed for consistency with Cormack and Lehane grading. 4) Optimization maneuvers required for intubation like jaw thrust, external laryngeal pressure and use of bougie. 5) Complications included incidence of airway trauma. Traumatic intubation was defined as the presence of any of the following: blood soiling on the tracheal tube on extubation, hoarse cry voice, and sore throat either straightaway after extubation or at 24–48 hours postoperatively. Intraoperative complications included bronchospasm, esophageal intubation, minor tongue/lip/dental trauma.

Postoperative complications included sore throat, hoarseness of voice, coughing, dysphagia, nausea and vomiting. Secondary outcome measures were derived following the intraoperative intubation characteristics in terms of vital parameters like heart rate, mean blood pressure, SpO_2, $EtCO_2$. It was noted at baseline, at the time of induction, at the time of intubation and 1, 2, 3, 4, 5, 10, 15, 30, 60, 90, 120 min after intubation and immediate postoperatively. So, we undertook this study to compare Airtraq video laryngoscope and Macintosh laryngoscope to see which method is better at outcomes. Sample size has been estimated with the help of the following study: "Airtraq versus Macintosh laryngoscope in intubation performance in the pediatric population" by Waleed Riad et al. [2] Regarding the study mentioned above and with the help of statistical software nMaster 2.0, considering α error=0.05, confidence interval=99% and power=90%, sample size came out as 30 patients in each of the groups. For better results, we have studied 40 patients in each group. The study population was randomly allocated to two groups using the envelope method and was double-blinded. Group A, in which Airtraq (pediatric size/small size) was used for endotracheal intubation and Group M, in which conventional Macintosh laryngoscope was used for endotracheal intubation.

Premedication was given 5 min before induction with injection (Inj) Glycopyrrolate 5 µg/kg intravenous (IV), Inj Paracetamol 5 mg/kg IV, Inj Midazolam 0.5 mg IV, Inj Ondansetron 0.1 mg/kg IV and Induction was done with pre-oxygenation for 3 min through a face mask and Jackson Rees Circuit with 100% oxygen. Inj Xylocard 1mg/kg was given. Induction of general anesthesia was done with Inj Propofol 2 mg/kg till loss of eyelash reflex. After confirmation of bag and mask ventilation, Inj Suxamethonium Chloride 2 mg/kg (IV) was given. Intubation was done by Airtraq (in the group A patients) or by Macintosh (in the group M patients) after the disappearance of fasciculation from toes and adequate jaw relaxation, and endotracheal tube (ET) was advanced towards glottis. Tracheal intubation was confirmed with bilateral equal air entry and capnography. Then Inj Vecuronium bromide 0.1mg/kg loading dose was given. Selection of size of Airtraq was done as per manufactures guidelines with ET tube size of 4, 4.5, 5, 5.5 in 2-8 years of pediatric group.

For statistical analysis, to arrange the observed parameters of every case, a master chart was prepared. Mean and Standard deviation (SD) values were taken out. Statistical analysis of the data for the various parameters was done using the student's 't' test for all continuous variables and the chi-square test was used for qualitative (nonparametric) data using MedCalc software. The significance of statistical analysis was judged by the P-value. $P > 0.05$ was not significant, $P < 0.05$ was considered significant and $P < 0.01$ was highly significant.

Results

The study comprised 80 subjects divided into two groups of 40 subjects each. Demographic and descriptive data of pediatric patients scheduled for elective surgical procedures under general anesthesia are presented in [Table 1]. The age range was three to twelve years in both groups. In Group A, airway assessment parameters like mouth opening, Mallampatti grading were comparable with similar airway assessment parameters of Group M, which was statistically not significant ($p > 0.05$). There were only two cases of esophageal intubations and two patients had a dental trauma in Group M, while no other complications were noted in both the group of patients. The result was not statistically significant ($p > 0.05$). The age, height, weight, gender wasn't statistically significant between the groups [Table 1].

Table 1
Demographic and descriptive data of pediatric patients scheduled for elective surgical procedures under general anesthesia in Group A (Airtraq) and Group M (Macintosh)

Parameters	Group-A	Group-M
Age (years)	7.3 ± 2.2781	8.12 ± 2.67
Sex (M: F)	23:17	25:15
Weight (kg)	22.73 ± 7.06	27.1 ± 6.51
ASA grading (ASA I: II)	29:11	28:12
Mouth opening	3.1 ± 0.21	3.10 ± 0.20

Mallampatti Grading	1.7 ± 0.56	1.73 ± 0.64
NJM	Normal	Normal

[Table 2] represents intubation characteristics. The difference between the time required for intubation within the two groups was significant ($p < 0.05$), because the time required for intubation in Group A was lesser than Group M. Attempts of intubation with Airtraq and Macintosh were comparable as in Group M only two patients required a second attempt of intubation while rest patients intubated in the first attempt whereas all intubations were done in the first attempt in Group A. Quality of visualization was better in Group A compared with patients in Group M. In Group A 35/40(97.5%) patients did not require any optimization maneuver and had the score zero, while 1/40(2.5%) required external laryngeal pressure and had the score one. In Group M, 22/40(55%) had a score of zero and 18/40 (45%) had a score of one. The optimization maneuver score of Group A was 0.025±0.15 andthat of Group M was 0.475±0.506 and the result was highly statisticallysignificant.

Table 2
Intubation time and other characteristics in Group A and Group M

Parameters	Group A (Airtraq) (n=40)	Group M (Macintosh) (n=40)	P Value
Time required for intubation	13.3 ± 2.13	21.7 ± 1.11	<0.05
Number of optimization manoeuvre	1/40 (2.5%)	18/40 (45%)	<0.001
First attempt of intubation	40(100%)	38(98.34%)	>0.05
Second attempt of intubation	0	2(6.67%)	>0.05
Quality of visualization (Cormack and Lehane Grading)	Grade I: 34/40 (85%) Grade II: 6/40 (15%) Grade III and IV: 0/40	Grade I: 28/40 (70%) Grade II: 12/40 (30%) Grade III and IV: 0/40	<0.05

[Figure 1] displays the mean of mean blood pressure. The mean blood pressures were statistically significant in both groups. Concerning the intergroup, the mean of mean blood pressure was significantly lower in Group A mainly after three min after intubation (66.3±7.032mmhg) compared to Group M (75.62±5.91mmhg).

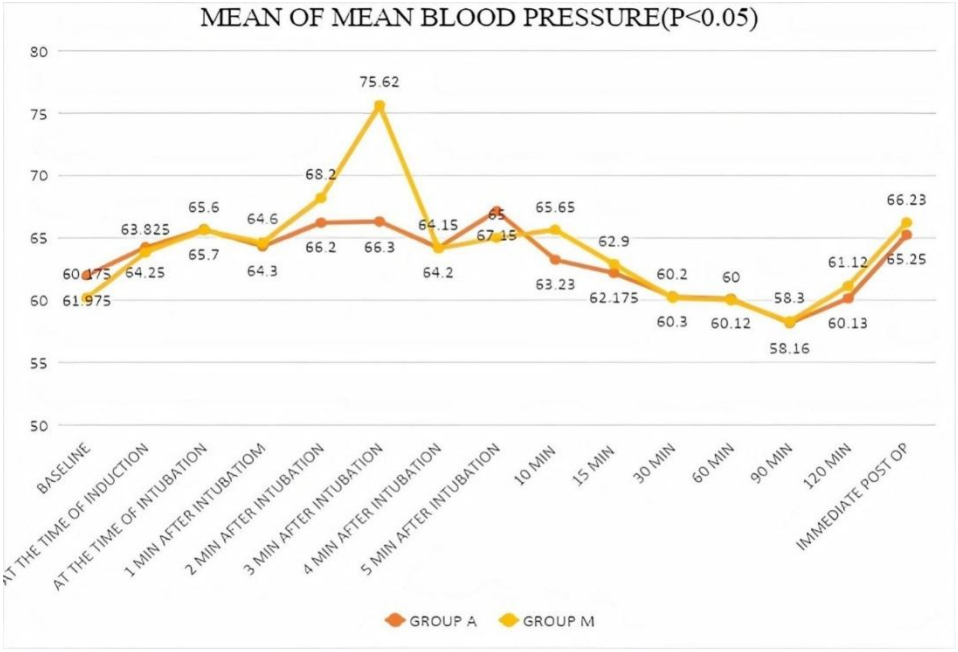

Figure 1. Blood pressure changes in the peri-induction periods in Group A and Group M

[Figure 2] shows the mean baseline pulse rate. It shows that three min after intubation mean pulse rate in Group A was 111.8±10.78 whereas in Group M was 132.4±5.38, which suggests that there was better hemodynamic stability in Group A compared to Group M. There were no harms or unintended effects in each group.

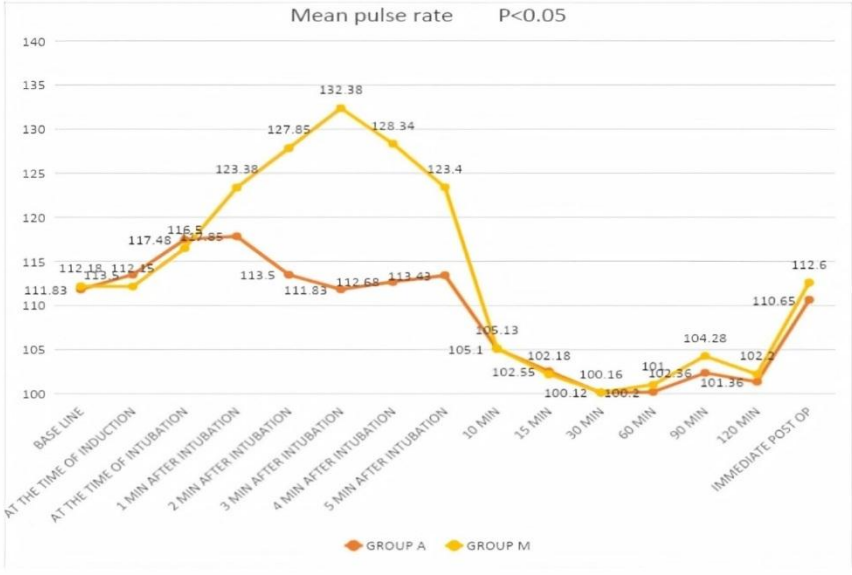

Figure 2. Pulse rate changes in the peri-induction periods in Group A and Group M

[Figure 3] shows that the oxygen saturation was comparable in both groups at every period. We did not encounter any episode of desaturation while intubation.

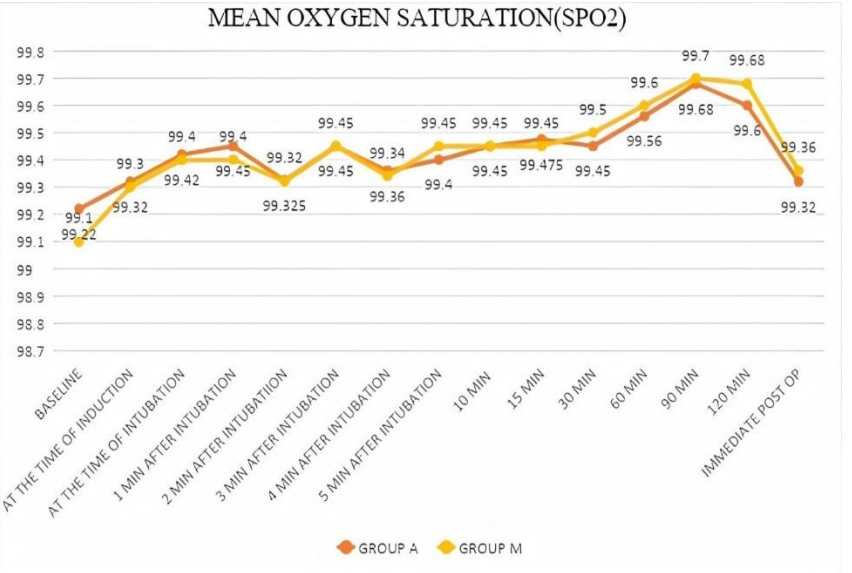

Figure 3. Mean oxygen saturation in the peri-induction periods in Group A and Group M

Figure 4 shows mean end-tidal carbon in Group A and Group M. The mean end-tidal carbon dioxide was comparable in both groups.

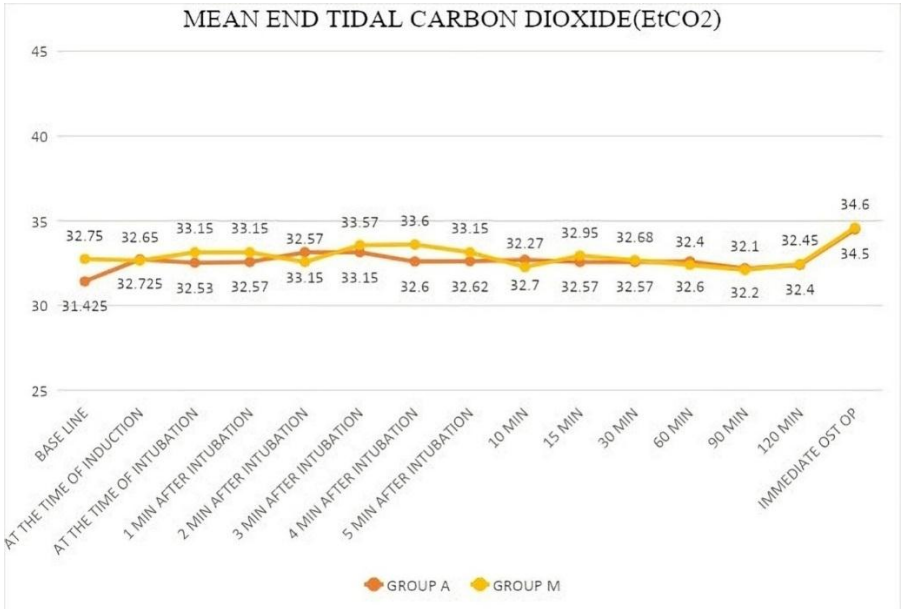

Figure 4. Mean end-tidal carbon dioxide in peri-induction periods in Group A and Group M

Discussion

In our study, the findings demonstrate that Airtraq video laryngoscope performed better than traditional intubation with the Macintosh laryngoscope. Laryngoscopy has come a long way since its first advent. In one study,[14] done in adults, they had an inference that both Airtraq and Macintosh laryngoscopes are similarly effective in tracheal intubation in normal airway but the time taken for successful tracheal intubation was quicker in the Airtraq group which was statistically significant. In a systematic review and meta-analysis study,[15] concluded that the Airtraq facilitates more rapid and accurate intubation, particularly when used by novices. In a randomized, controlled clinical trial,[16] a comparison of ease of intubation with the Airtraq and Macintosh laryngoscopes in patients with cervical spine immobilization was done. They concluded that tracheal intubation with the Airtraq caused fewer changes in blood pressure and heart rate. These findings demonstrated the utility of the Airtraq laryngoscope for tracheal intubation in patients with cervical spine immobilization. In another randomized controlled trial [17] which aligned with ours, they observed that patients of both groups had a similar percentage of glottic opening visibility. Whereas they also included the patients with Mallampatti scoring I, II, III, and IV.

They did not encounter esophageal intubation using both these video laryngoscopes but airway trauma occurred in 2 patients of the Airtraq group and 1 patient of the King Vision group. In our study, there were only two cases of esophageal intubations and two patients had a dental trauma in Group M, while no other complications were noted in both the group of patients. The result was not statistically significant. There was no significant difference in attempts of intubation with these devices between the two groups. In a comparative study,[18] there was an observation that there is a greater necessity for optimization maneuvers with direct Macintosh than C-Mac and Glidescope while no maneuvers were needed for Airtraq. Our study suggests that optimization maneuvers were less required in Group A compared to Group M. Whereas in another study,[19] they observed negligible changes in oxygen saturation. The mean end-tidal carbon dioxide was comparable in both groups. In our study, the oxygen saturation was comparable in both groups at every period. We did not encounter any episode of desaturation while intubation. They observed the median time for successful intubation to be 38 secs using the channeled blade with King Vision video laryngoscope.

The Airtraq laryngoscope facilitates quicker and precise intubation, particularly when used by beginners or trainees.[20] In a comparative study between Airtraq and Macintosh,[21] there was an evaluation of the Airtraq and Macintosh laryngoscopes in patients at increased risk for difficult tracheal intubation and concluded that Airtraq decreased the requirement for extra maneuvers, and the intubation difficulty score and the duration of intubation attempts. Tracheal intubation with the Airtraq reduced the degree of hemodynamic stimulation and negligible trauma when compared to the Macintosh laryngoscope inpatients of probable tough tracheal intubation. A randomized pilot study [22] was done for Endotracheal intubation between Airtraq and Storz video laryngoscope in children younger than two years and concluded that there wasn't change in the success rate of endotracheal intubation that could be established. But, the Airtraq had

numerous time-related advantages over the Storz video laryngoscope. A study comparing the Airtraq with conventional laryngoscopy [23] during routine anesthesia in children was done and there was a conclusion that although the Airtraq laryngoscope provides an improved vision of the larynx compared with conventional laryngoscopy, tracheal intubation takes a longer time. However, in our study, we came to a conclusion that Airtraq video laryngoscopy decreases intubation time, number of attempts, quality of visualization and optimization maneuvers, compared with Macintosh laryngoscope pediatric patients. Routinely video laryngoscope isn't utilized in pediatric patients. So, we undertook this study to determine and compare the efficacy of Macintosh laryngoscope and Airtraq video laryngoscope of pediatric size with Airtraq wireless recorder for intubation time, a number of attempts, quality of visualization, optimization maneuvers and perioperative management.

Conclusion

Statistically lesser time was required for intubation, better visualization of glottis and more hemodynamic stability with Airtraq video laryngoscope compared to theMacintosh laryngoscope. However, both devices are useful for routine intubation in pediatric patients.

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