THE USE OF AIRTRAQ LARYNGOSCOPE VERSUS MACINTOSH LARYNGOSCOPE AND FIBEROPTIC BRONCHOSCOPE BY EXPERIENCED ANESTHESIOLOGISTS

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Abstract

Objective: The aim was to compare the hemodynamic parameters, intubation times, upper airway trauma and postoperative sore throat scores of the patients with normal airway anatomy, intubated with the Airtraq, Macintosh laryngoscope and fiberoptic bronchoscope, by experienced anesthesiologists.

Methods: Ninety patients, scheduled to undergo elective surgery under general anesthesia were randomly divided into three groups (n=30): Group A: Airtraq laryngoscope, Group M: Macintosh laryngoscope and Group FB: fiberoptic bronchoscope. The time to intubation and success rates were recorded. The hemodynamic parameters before and one minute after the anesthesia induction were recorded and the measurements were repeated 3, 4 and 5 minutes after the endotracheal intubation. The postoperative sore throat scores and signs of any trauma were also recorded.

Results: Mean arterial blood pressure and heart rate were not significantly different between the three groups. The mean intubation time interval did not differ between groups. Highest postoperative sore throat scores were recorded at the 6th hour post extubation. The scores were 37.6 ± 20.9 in Group A, 13.3 ± 16.8 in Group M and 13.6 ± 14.0 in Group FB. The scores in Group A were significantly higher compared to other groups. The number of patients requiring additional analgesia to relieve sore throat was also significantly higher in Group A.

Conclusion: The Airtraq laryngoscope seems to be a more traumatic airway device in the routine endotracheal intubation compared to Macintosh laryngoscope and fiberoptic bronchoscope, when used by experienced anesthesiologists. It also does not offer advantage over the first-attempt success rates, the intubation times and hemodynamic parameters.

Keywords: airway management; laryngoscope; Airtraq; Macintosh laryngoscope; fiberoptic bronchoscope; intubation.

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Introduction

Recent technological advances including the light-emitting diodes, rechargeable batteries, optical systems with adjustable position capability and modified laryngoscope blades allowed the development of new devices such as Airtraq laryngoscope (Airtraq, Prodol Meditec Limited, China), to facilitate and improve the success rate of endotracheal intubation[1,2]. Although originally designed to facilitate difficult intubation, thesee devices can also be used in the management of the normal airway[1,2].

The special design of the Airtraq allows the direct exposure of the glottic opening without the necessity of optimal alignment of the oral, pharyngeal and laryngeal axes. The results of the meta-analysis comparing the Airtraq with the conventional Macintosh laryngoscope concluded that the use of Airtraq results in a rapid and accurate intubation[3]. The Macintosh laryngoscope possess a curved blade facilitating the glottic view, reducing potential tongue and epiglottic trauma. The use of the fiberoptic bronchoscope (FOB, Pentax Corporation, Japan) is of great value in performing endotracheal intubation, but with the main disadvantage for being of high cost, and the need for long practical experience.

Studies on the effectivity and complications of the Airtraq and FOB are mainly conducted on manikins[5-8]. In these studies, the intubations are mainly performed by novices or paramedics[5,6]. To our knowledge, a comparison of the endotracheal intubation with Airtraq, Macintosh laryngoscope and FOB performed by the experienced anesthesiologists is lacking. Furthermore, determination of the postoperative sore throat incidence and airway trauma is not possible in manikins or in simulation scenarios.

The purpose of this study was to compare the hemodynamic parameters, intubation times, complications during and after intubation and postoperative sore throat scores of the patients having normal airway anatomy, intubated with Airtraq, Macintosh laryngoscope or FOB, by experienced anesthesiologists. The primary outcome variables were the first-attempt success rate, time to successful intubation. The secondary outcome variables were the effects of the intubation on hemodynamic parameters, the postoperative sore throat scores and trauma to the upper airways.

Methods

Following the approval of the Marmara University Ethics Committee, 90 patients, aged between 18-65 years, with American Society of Anesthesiologists (ASA) physical status classification of 1 or 2, undergoing elective surgery under general anesthesia and requiring endotracheal intubation were included in the study. The exclusion criteria for participation in this study were: patients with ASA 3 or 4, Mallampati score of 3 or 4, history of difficult intubation, thyromental distance less than 6.5 cm, sternomental distance less than 12.5 cm, body mass index higher than 35 kg/m^2 and limited neck mobility.

All patients gave their written informed consent. A prospective and randomised study design was employed and the randomisation was done with the help of a random number generator downloaded from 'http// www.random.org'[9]. The endotracheal intubations were performed by three experienced anesthesiologists. Anesthesiologists who had practiced at least 500 intubations with the Macintosh laryngoscope, 50 intubations with the FOB were considered as being 'experienced'[10]. The preoperative Mallampati scores were recorded and maximum mouth opening, thyromental and sternomental distances of the patients were measured. All patients were premedicated with 0.015 mg/kg IM atropine sulphate and 0.07 mg/kg IM midazolam. The patients' positions in the operation room were supine with no pillow under the head. Monitoring included electrocardiogram, noninvasive blood pressure and peripheral pulse oximetry (SpO_2), end tidal carbon dioxide ($ETCO_2$) and end tidal sevoflurane concentrations. Preoxygenation was not performed. Anesthesia was induced with 5-7 mg/kg IV thiopental sodium and 0.6 mg/kg IV rocuronium bromide. The administration of the opioid analgesics was not allowed in the induction period.

The patients were randomly divided into three groups (n=30) and orotracheal intubated with Airtraq (group A), Macintosh laryngoscope (group M) and FOB (group FB). In group A, the standard inventor's technique was used. Airtraq was positioned into the

vallecula and upward lifting of the epiglottis made glottic opening visible. The tube was then inserted to the trachea. In group M, direct laryngoscopy was performed with a Macintosh blade size 3. In group FB, endotracheal intubation was performed with a FOB with attached tracheal tube. If a satisfactory vision was not achieved in any group, the applications of optimization maneuvers such as jaw thrust, tracheal pressure, lifting, tilting or orientation of devices or the assistance of a second person were allowed and recorded. Train-of-four (TOF) (Watch SX; Organon Ltd Drynam Road Swords, Co. Dublin, Ireland) was used to measure the level of neuromuscular blockade. Anesthesia was maintained with 1 MAC sevoflurane and %70 N_2O in oxygen.

The intubation time (the time from the device insertion into the oral cavity and the view of the tube crossing the vocal cords) was measured by a chronometer. The intubation was failed, if it could not be performed less than 120 seconds. In this instance the patient was excluded from the study. Complications such as esophageal intubation, upper airway mucosa laceration, dental trauma or iatrogenic endotracheal cuff rupture were noted. The success or failure of the process was also recorded. Mean arterial blood pressure, heart rate, SpO_2 and $ETCO_2$ concentrations were measured before the anesthesia induction (0. min) and one min after the induction. The time interval between anesthesia induction and endotracheal intubation was considered to be 2 min. Hemodynamic parameters were also recorded 3, 4 and 5 min after the intubation.

Meperidine hydrochloride 1 mg/kg IV was administered to all patients in the early postoperative period. At the end of 30 minutes, the sore throat scores of the patients were evaluated after direct questioning, using a 0-100 mm visual analogue scale (VAS). Postoperative sore throat VAS scores were recorded at the 6^{th}, 12^{th} and 24^{th} hour. The anesthesiologist evaluating the postoperative sore throat scores was blinded to the intubation devices used. Patients having VAS scores higher than 30 mm were administered 20 mg IV meperidine hydrochloride as a rescue analgesic. In all patients, 1 mg/kg meperidine hydrochloride IV was given every 6 h for the first 24 h, as a postoperative analgesia.

Statistical Package for Social Sciences for Windows (SPSS) version 20.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. One of the primary outcomes was the time to successful tracheal intubation. Based on previously published studies[11,12], we estimated that 24 patients would be required for each group to detect a mean difference of 6 seconds in the overall duration of intubations, between groups, with a power of 80% and a significance level (a) of 0.05. So, we enrolled 30 patients per group. Data are summarized using mean ± SD for continuous variables. Statistical comparisons between the groups were performed using analysis of variance (ANOVA) with Kramer as a post hoc test. Repeated parameters were analysed by repeated measures ANOVA, with Newman-Keuls as a post hoc test. Data for the success of tracheal intubation attempts, the differences between patients with or without complications were investigated by Fisher's exact test. $P < 0.05$ was considered statistically significant.

Table 1

Patient characteristics of groups

	Group A	Group M	Group FB	P
Age (Years)	42.3 ± 13.5	40.7 ± 17.0	43.2 ± 14.5	0. 631
Weight (kg)	72.7 ± 12.9	70.7 ± 13.0	73.3 ± 13.1	0.891
Height (cm)	168.6 ± 9.5	166.9 ± 9.4	169.8 ± 9.6	0. 631
Male/Female ratio	16/15	14/16	15/15	0.875
Sternomental distance (cm)	13.6 ± 1.9	13.5 ± 1.0	13.8 ± 1.4	0. 491
Thyromental distance (cm)	7.41±1.54	7.36±1.63	7.93±1.78	0.265

Table 2

Maximal mouth opening (cm), intubation time (sec) and first attempt success rate

	Group A	Group M	Group FB	P
Maximal mouth opening (cm)	5.1 ± 1.71	4.7 ± 1.41	4.45 ± 0.69	0. 223
Intubation time (sec)	11.23 ± 2.90	9.46 ± 2.70*	9.96 ± 1.82	***0.009***
First attempt success rate	4 (13.3%)	2 (6.7%)	2 (6.7%)	0.578
End-tidal CO_2	34.16±2.19	33.18±2.47	32.68±2.92	0.192

* Difference with Group A $p < 0.05$.

Table 3

Patients requesting additional analgesia to relieve sore throat

	Group A	Group M	Group FB	P
30. min	*46.6 %	13.3 %	6.6 %	***0.000***
6. h	*63.3 %	23.3 %	16.6 %	***0.000***
12. h	*50.0 %	16.6 %	13.3 %	***0.002***
24. h	*50.0 %	6.6 %	3.3 %	***0.000***

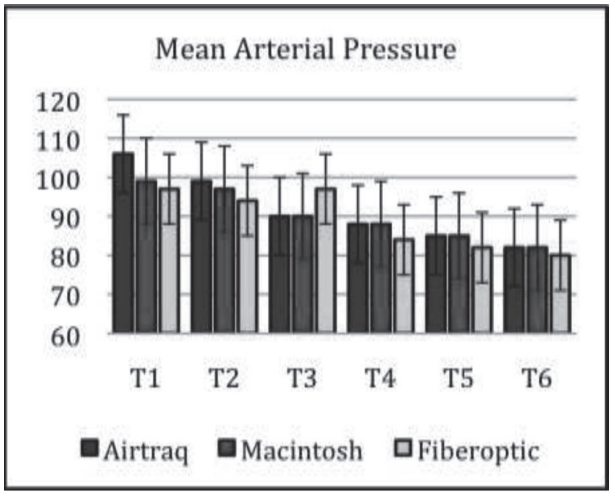
* Difference with Group A $p < 0.05$.

Results

Ninety patients were included in the study. Demographic data of the three groups were similar (Table 1). There were no statistical differences between groups regarding maximum mouth opening, sternomental and thyromental distance and time to endotracheal intubation (Table 1 and 2). The mean arterial blood pressure and the heart rate values of the three study groups were not significantly different throughout the study period (Figure 1 and 2). End-tidal carbon dioxide concentrations were 34.16, 33.18 and 32.68 mmHg in groups A, M, FB respectively and SpO_2 values were 98.36%, 98.54% and 98.62% in groups A, M, FB respectively in the first 5 min, with no statistical

Fig. 1

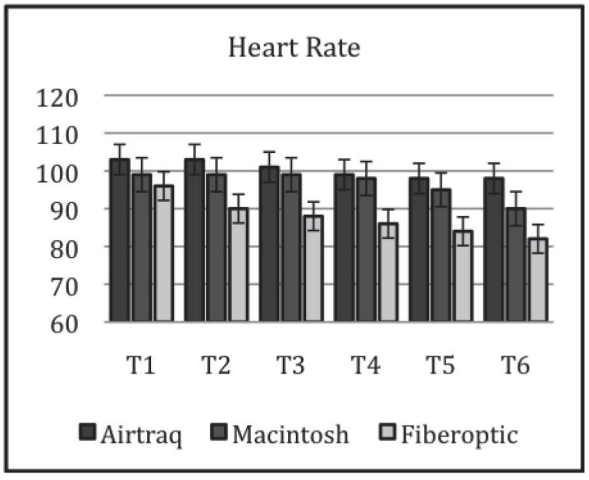
Mean arterial blood pressure (mmHg)



T1: 0. min, T2: 1. min, T3: 2. min, T4: 3. min, T5: 4. min, T6: 5. Min

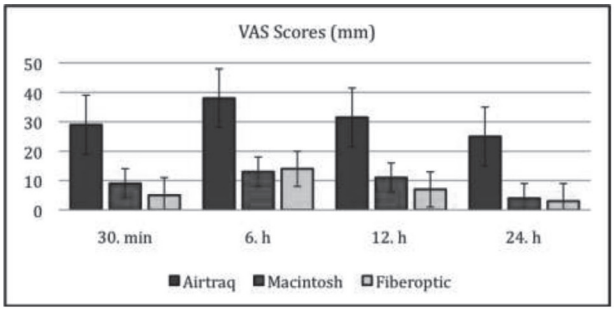
Fig. 2

Heart rate (beat/min)



T1: 0. min, T2: 1. min, T3: 2. min, T4: 3. min, T5: 4. min, T6: 5. Min

Fig. 3
VAS scores of patients for postoperative sore throat



difference between groups. The highest postoperative sore throat VAS scores were recorded at the 6th h in all groups, the significantly highest scores were found in group A (Figure 3). At all times, sore throat VAS scores of the group A were significantly higher compared to other groups ($p< 0.01$) (Figure 3). The percentage of patients requiring rescue analgesics to sore throat was significantly higher in group A ($p< 0.05$) (Table 3). All patients in the study were successfully intubated. On removal of the laryngoscope following intubation, blood spot on the blade was observed in 4 patients in group A, but a detailed intraoral examination revealed nolaceration or lesion. Complications such as esophageal intubation, dental trauma or iatrogenic endotracheal tube cuff rupture were not observed in any patients in all groups. The help of another anesthesiologist was required in 4 patients in group A and for 2 patients in group F. The rotation maneuver was used in 6 patients in group A. None of the patients in all groups required jaw thrust maneuver.

Discussion

The results of the present study indicate that the use of Airtraq by experienced anesthesiologists may be more traumatic in the endotracheal intubation of patients with normal airways, without shortening the time for successful intubation when compared to Macintosh laryngoscope and FOB.

Airtraq use on manikins and simulators is widely investigated in novices, but little is known about the efficacy and complications of the Airtraq device when used by experienced anesthesiologists[13,14]. Furthermore, the exact incidence of sore throat or mucosal injury caused by the Airtraq is hard to determine, because studies on this field are mainly manikin studies. Airtraq facilitates endotracheal intubation in a more rapid manner than the Macintosh laryngoscope and it is user friendly, especially when used by novices[3]. Its main advantage is that it allows the visualization of the glottis without the need of alignment of the oral, pharyngeal and tracheal axes. The Macintosh laryngoscope retracts the tongue and epiglottis, exposing the oral, pharyngeal and tracheal axes in a straight line. Correct laryngoscope handling and correct interaction of the Macintosh blade with the perilaryngeal structures necessitate anesthesiologist's experience, whereas Airtraq may easily be used by unskillful anesthesiologist residents or novices[15]. The superiority of the Airtraq over Macintosh laryngoscope in patients at increased risk for difficult intubation and simulated difficult airway scenarios has been demonstrated, when used by experienced anesthesiologists[16,17]. It also seems that the Airtraq may be a good choice for the use by novices and inexperienced laryngoscopists who are not used to perform routine endotracheal intubation. Nevertheless, to our knowledge there is no clinical study comparing the hemodynamic parameters, intubation times, sore throat scores and upper airway trauma incidence in patients with normal airways intubated with fiberoptic bronchoscope, Airtraq and Macintosh laryngoscope, by experienced anesthesiologists.

Hemodynamic parameters and time to intubation were similar between groups, indicating that Airtraq does not offer any advantage in these regards. These results are not surprising since anesthesiologists involved to the study are all experienced in the use of these devices.

The presence of blood spot on the tip of the device and significantly high postoperative sore throat scores in our patients intubated with Airtraq, suggest that the Airtraq may be a potentially traumatic device, when used in patients with normal airway anatomy. Upper airway injury is possible during laryngoscopy[18]. Dental trauma, tongue lacerations or hematomas are the most commonly encountered upper airway injuries related to the use of various endotracheal intubation devices. Injury to the tongue is usually related to the force applied by the laryngoscope on the tongue[19].

Gaszynski[20] suggested that the use of Airtraq resulted in less pressure on the tongue compared to the Macintosh laryngoscope. We observed blood spot on the tip of the device in 4 patients, following the removal of the Airtraq. Although a detailed intraoral examination revealed no laceration, we suggested that the Airtraq use may result in minor trauma to the upper airway. The presence of blood on the tip of the device suggests that trauma made by the Airtraq is not related to the force applied on the tongue, but on the force applied to the vallecula. Similar to Macintosh laryngoscope, adjusting the position of Airtraq in the pharynx is required. In accordance with the habituel practice with Macintosh laryngoscope or to optimise the view of the glottis, the blade of the Airtraq can be intuitively lifted up. In the literature, some intuitive small amplitude movements performed by the anesthesiologists are already described[21]. These maneuvers may easily harm the vallecula in normal airways. Maharaj et al.[10] suggested that in patients at increased risk for difficult tracheal intubation, minor force has to be applied during laryngoscopy with the Airtraq device because there is no need to align the oral, pharyngeal and tracheal axes. Depending on previous studies demonstrating the success of Airtraq on tracheal intubation in patients with difficult airway, it may be hypothesized that the exaggerated curvature of the Airtraq blade may easily improve the glottic exposure in abnormal airways with anteriorly located larynx[22,23]. Dhonneur et al.[21] found that anaesthesiologists learning to use the Airtraq in patients with potentially difficult airways, are placing the Airtraq in the pharynx with a significant distal pressure on the tip of the blade to overcome the narrowing at the junction between the oral and pharyngeal spaces. We suggest that in normally positioned larynx also, the tip of the blade may apply some pressure to the vallecula. A detailed examination of the upper airway did not reveal any mucosal injury but the examination of the vallecula was not performed in order not to affect the postoperative sore throat scores.

A positive correlation is determined between force used during intubation attempts and incidence of complications such as sore throat intensity[19]. Postoperative sore throat scores were high in the Airtraq group. Optimization maneuvers were common in the use of Airtraq and in order to perform the intubation, the rotation maneuver was obligatory in 6 patients intubated with Airtaq. These findings may also explain that more forces had to be applied to the patients during the use of Airtraq.

The major limitation of our study was that we did not record any videos during airway manipulation of the patients and internal views of the larynx.

Conclusion

The Airtraq use in patients with normal airway anatomy may result in minor upper airway trauma and significant sore throat. Experienced anesthesiologists are able to intubate the patients with normal airway anatomy with devices requiring skill and familiarity, such as Macintosh laryngoscope or FOB. According to the results of this study, we underline that the Airtraq should not take place in the routine endotracheal intubation practice of the patients with normal airways, in the hands of experienced anesthesiologist; the use of the airtraq should be limited to the manipulation of patients with difficult airways and limited neck extension.

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Abbreviations

FOB: fiberoptic bronchoscope, ASA: American Society of Anesthesiology, IM: intramuscular, IV: intravenous, SpO_2: peripheral pulse oximetry, $ETCO_2$: end tidal carbon dioxide, TOF: Train-of-four, VAS: visual analogue scale, SPSS: Statistical Package for Social Sciences for Windows, ANOVA: analysis of variance.

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