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Comparison of Truview EVO2 Videolaryngoscope and Macintosh Laryngoscope in pediatric patients

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ABSTRACT

We aimed to compare Trueview EVO2 laryngoscope and Macintosh laryngoscope in terms of hemodynamic response and intubation conditions for pediatric patients. 100 children aged between 1 month and 4 years were included in the study. Patients were randomly divided into 2 groups. Intubation was performed via Macintosh laryngoscope in Group DL and via Trueview EVO2TM videolaryngoscope in Group VL. Heart rates were similar between the two groups. Systolic, diastolic and mean blood pressures 1 minute after the intubation were significantly higher in Group VL. There was no significant difference between groups in terms of SpO2 levels, TD, airway demand, cricoid pressure or Cormack-Lehane scores. End-tidal CO2 levels were significantly higher in Group VL. Difficulty occurred while inserting the tube in 6 patients in Group VL but in none of the patients in Group DL. Intubation durations were higher in Group VL (17.81±1.31 sec) than in Group DL (17.00±1.20 sec). There was no statistically significant difference in terms of intubation related complications. In pediatric patients, better laryngeal visualization is acquired with Trueview videolaryngoscope but intubation duration prolongs and has no advantage on intubation success.

1. Introduction

Opening the airway and keeping it open is one of the main responsibilities of the anesthetist. Delays in opening the airway may result in irreversible damage or death in the hypoxic and anoxic brain. For this reason, it is the most important task of the anesthetist to assess the airway and make the necessary preparations to ensure that the airway is open and kept open. The continuity of vital functions depends on the opening the airway and keeping it open (Toker, 2012). Despite the new tools and techniques in airway management, endotracheal intubation remains the gold standard in securing the airway (Vlatten et al., 2009).

In pediatric airway management, it is important to know the anatomical differences between a child's and an adult's upper airway. An appropriate history and physical examination, appropriate endotracheal tube and laryngoscopy choice are the key points in pediatric airway management (Infosino, 2002).

Functional residual capacity (FRC) is lower in children due to the fact that the chest wall compliance is more, and the lung compliance is less than that of adults. This decline in FRC limits oxygen reserves in children during apnea periods (Berry and Castro, 2006). Failure of intubation or prolonged duration of intubation may cause serious complications in children. For this reason, it is important to take control of the airway in a short period of time (Morgan et al., 2008).

In this study, we aimed to compare the Truview EVO2TM laryngoscope, a newly developed videolaryngoscope type and not widely used in the pediatric age group, with the Macintosh laryngoscope, which is routinely used, in terms of hemodynamic response and intubation conditions.

2. Material and methods

After the approval of the University Ethics Committee, parents of the patients were informed about the study, and their written approval was obtained.

A total of 100 children aged between 1 month and 4 years with an ASA (American Society of Anesthesiologists) classification of I-II-III were included in the study, which were planned to undergo elective surgery and to be operated under general anesthesia. The patients were randomly divided into two groups.

Group DL: Those that were subject to intubation with Macintoch blade laryngoscope

Group VL: Those that were subject to intubation with Truview EVO2TM videolaryngoscope

Age, gender, weight, height, ASA and thyromental distance (TD) values were recorded in the preoperative examinations of the patients. No premedication was given to the patients. Intubation was performed in both groups by a 5-year specialist student, who used a Truview EVO2TM videolaryngoscope in 30 adult and 20 pediatric patients. During the intubation, head was held in neutral position, and a probe was used.

Patients with oxygen saturation (SpO2) of less than 94% in the preoperative room air or who were expected to have a power airway were not included in the study. Attempts with prolonged intubation durations (longer than 10 minutes) and attempts with incomplete intubation after 3 attempts were considered unsuccessful and were left out of the study. During the intubation procedure, the intubation was considered to be unsuccessful when SpO2 fell below 94%. In such cases, the patient underwent mask ventilation with 100% oxygen, and was switched to alternative methods. After the patients were taken to the operation room, all of them were monitored for heart rate (HR), noninvasive blood pressure, SpO2, and end-tidal carbon dioxide (ETCO2), using the "Preoperative standard monitorization" electrocardiography (ECG).

In both groups, anesthesia induction was started with 6% sevoflurane inhalation anesthesia and 100% oxygen. An additional 0.2 μg/kg/h remifentanil infusion was applied to the anesthesia. Intravenous 0.2 mg/kg cisatracurium was administered to relieve muscles, after seeing that mask ventilation was comfortable, and the lungs were ventilated. Patients were intubated at the end of three minutes of mask ventilation. In both groups, the duration of intubation was recorded as the time elapsed from the time the vocal cords were seen until the ETCO2 was seen on the monitor. The airway demand during mask ventilation and the need for cricoid pressure during intubation procedure were recorded. The number of attempts until reaching the successful endotracheal intubation was recorded. Laryngoscopy intervention was recorded as easy, moderate, difficulty, and impossible. The reasons for intubation difficulty (difficulty in seeing the larynx, difficulty in seeing the tube, difficulty in both) were recorded. Complications (bleeding, laceration, dental damage, etc.) during intubation were recorded.

In both laryngoscopy methods, a glottic image was recorded using the Cormack-Lehane (C&L) scoring system. Scores were recorded as I, II, III, or IV. Cases with C&L scores of III-IV were excluded from the study.

Hemodynamic parameters of the patients including HR; systolic (SBP), diastolic (DBP), mean (MBP) blood pressures; and SPO2 values were recorded preoperatively, at induction, and 1, 2, 3, 4, 5 and 10 minutes after intubation. ETCO2 values were also recorded at 1, 2, 3, 4, 5 and 10 minutes after intubation.

Statistical analysis

In order to determine the sufficient number of cases, the study of Singh et al. (Singh et al., 2009) was referred to. Using the Minitab program, the number of patients in both groups was determined as 50 at a level of $\alpha = 0.05$ with 99% confidence limit and 99% confidence.

Statistical analysis of the data obtained in this study was performed using the "Statistical Package for Social Sciences (SPSS) for Windows 16.0" program. Whether the obtained data were normally distributed was investigated using the Shapiro-Wilk test. The Mann-Whitney U test was used to compare the groups with non-normal distributions. The Chi-square test was used to compare the data obtained by counting.

The data were expressed in means, standard deviations, numbers and percentages. p 0.05 was considered significant.

3. Results

There were no statistically significant differences between the two groups in terms of demographic characteristics (age, height, weight, ASA and gender) (p=0.647, 0.362, 0.129, 0.186, 0.149, respectively). The SpO2 and HR values of the groups were similar ($p>0.05$). Post-intubation first minute SAB, DAB and OAB measurements were statistically significantly higher in Group VL (Table 1, 2, 3).

Table 1. Groups systolic blood pressures.

	DL (n=49), (ort ± SD)	VL (n=48) (ort ± SD)	P
Preoperative	104.06 ± 15.43	107.08 ± 13.19	0.053
Induction	89.63 ± 12.85	93.04 ± 11.39	0.126
Intubation 1. minute	98.69 ± 13.26	105.45 ± 16.66	0.040
Intubation 2. minute	94.34 ± 12.57	98.12±11.74	0.088
Intubation 3. minute	92.61 ± 12.06	95.22 ± 9.92	0.110
Intubation 4. minute	91.32 ± 11.99	94.27 ± 10.71	0.138
Intubation 5. minute	89.36 ± 12.02	92.33 ± 9.94	0.072
Intubation 10. minute	90.08 ± 11.59	93.02 ± 9.45	0.077

Table 2. Groups diastolic blood pressures.

	DL (n=49), (ort ± SD)	VL (n=48) (ort ± SD)	P
Preoperative	63.22 ± 14.54	66.22 ± 16.07	0.412
Induction	52.61 ± 13.06	53.70 ± 12.41	0.513
Intubation 1. minute	68.85 ± 16.06	79.56 ± 21.32	0.007
Intubation 2. minute	56.85 ± 13.45	59.97 ± 13.01	0.100
Intubation 3. minute	54.24 ± 12.89	56.87 ± 12.60	0.109
Intubation 4. minute	54.12 ± 12.73	55.56 ± 13.68	0.484
Intubation 5. minute	51.46 ± 13.50	55.12 ± 12.81	0.074
Intubation 10. minute	51.16 ± 11.19	55.06 ± 14.43	0.146

Table 3. Groups mean blood pressures.

	DL (n=49), (ort ± SD)	VL (n=48) (ort ± SD)	P
Preoperative	80.34 ± 14.96	83.72 ± 17.30	0.304
Induction	68.10 ± 12.38	70.08 ± 12.77	0.302
Intubation 1. minute	76.85 ± 13.01	82.47 ± 15.16	0.039
Intubation 2. minute	73.20 ± 12.93	75.45 ± 11.99	0.170
Intubation 3. minute	71.22 ± 11.80	72.18 ± 10.83	0.484
Intubation 4. minute	69.61 ± 11.63	72.79 ± 13.14	0.258
Intubation 5. minute	68.20 ± 13.10	71.56 ± 11.02	0.169
Intubation 10. minute	66.63 ± 12.12	71.25 ± 10.71	0.053

In comparison between the groups, ETCO2 values were statistically significantly higher in Group VL at all measurement intervals ($p<0.001$). There were no statistically significant differences between the groups in terms of TD lengths, airway demand, cricoid pressure and Cormack-Lehane score ($p>0.05$) (Table 4).

Table 3. Groups intubation parameters.

	DL (n=49)	VL (n=48)	P
TM Distance (cm) (ort, SD)			
Airway need (n, %)			1.00
Yes	7(%14.3)	6(%12.5)	
No	42(%85.7)	42(%87.5)	
Cricoid pressure (n,%)			1.00
Yes	3(%6.1)	6(%12.5)	
No	46(%93.9)	42(%87.5)	
Cormack - Lehane I (n,%)	37 (%75.5)	38 (%79.2)	0.851
Cormack - Lehane II (n, %)	12 (%24.5)	10 (%20.8)	

During the intubation procedure, difficulties were encountered when guiding the tube in 6 patients in Group VL, while in Group DL, no difficulties were encountered in any patients (p=0.03).

Intubation times were significantly longer in Group VL (17.81 ± 1.31 sec) than in Group DL (17.00 ± 1.20 sec) (p=0.002).

There was no statistically significant difference in the number of attempts in the intubation process of the groups (p=0.466).

In Group VL, 2 patients were excluded – one due to the difficulty of laryngoscopy attempt and SpO2's falling down to 92%, the other due to unsuccessful intubation at the third attempt – and in Group DL, 1 patient was excluded.

4. Discussion

Today, the failures or difficulties in ensuring open airway during anesthesia practice are important causes of anesthesia-related morbidity and mortality. ASA reports difficult intubation as the third most common respiratory-related cause of death and permanent brain damage (Peterson et al., 2005). Compared to adults, intubation is more difficult in pediatric patients because there are significant differences in pediatric airway anatomy and respiratory system, and difficult airway is encountered more often (Kurt et al., 1998). Since pediatric patients have less oxygen reserves, they can rapidly develop hypoxia and then cardiac arrest when encountered with difficult airways. For this reason, it is extremely important to take control of the airline in children in a short period of time.

A line of sight is needed along the blade to see the glottic gap using the direct laryngoscopy; the angle of view is limited to oropharyngeal structures and measured as 15° (Vlatten et al., 2009). It is possible to improve the visibility of the glottis by increasing the visibility with the video camera system placed on the blade tip (Vlatten et al., 2009). The primary role of videolaryngoscopy is to achieve better performance in intubation, which is difficult or even impossible with standard methods (Ozkan, 2011).

Storz Miller 1 videolaryngoscope and the Miller 1 direct laryngoscope were observed on simulating difficult intubated infants (Fiadjoe et al., 2009). 32 pediatric anesthesiologists who participated in the study attempted intubation using random videolaryngoscope and direct laryngoscope. Using direct laryngoscopy, 40% of the anesthetists reported glottic vision as Grade III-IV and the entire videolaryngoscope as Grade I-II. And, the C&L score was significantly higher in direct laryngoscopy. Intubation times were recorded as similar in both groups. In a newborn with Desbuquois syndrome who had hypoplasia and microstomy on the face, and a short neck, C&L score were assessed as Grade IV using laryngoscopy with the Miller 0 blade, then at the second laryngoscopic evaluation the C&L score was graded as Grade III, after that the glottic opening was graded as Grade I using the Miller 1 pediatric videolaryngoscope for endotracheal tube instability, and intubation was performed (Samuel et al., 2008). They reported that videolaryngoscopy is a useful method when encountering a difficult newborn airway.

Hackell performed intubation in three separate cases with difficult airway history using videolaryngoscopy and performed intubation by evaluating the C&L score as Grade I. In the presence of difficult and/or unsuccessful direct laryngoscopy, they have come to the conclusion that videolaryngoscopy methods have proven to be an alternative method for babies in airway management (Hackell et al., 2009).

Vlatten compared the Storz videolaryngoscope and standard direct laryngoscope in children. The C&L score was recorded as a percentage of glottic gap and was found to be 97.5% (60-100%) in direct laryngoscopy and 100% in Storz videolaryngoscope. In the study, reported that Storz videolaryngoscope improved the glottic gap percentage score in children with normal airway anatomy (Vlatten et al., 2009).

The C&L scores were similar in our study. Most adult and pediatric studies with videolaryngoscopy have shown that the wide angle of blade and better visualization of the laryngeal structures on the screen during intubation attempts resulted in better image quality. In our study, however, no statistically significant difference was found between Cormack-Lehane scores in accordance with the study performed by Vlatten et al. (2009). This may be due to the fact that patients that were expected to have airway difficulty in the preoperative evaluation were not included in the study.

Kim have compared Macintosh laryngoscope and GlideScope videolaryngoscope in 203 pediatric patients. The duration of intubation was recorded as 36.0 sec in the group for which the GlideScope videolaryngoscope was used and 23.8 sec in the group for which the direct laryngoscope was used. As a result, they have reached the conclusion that in children, intubation with GlideScope videolaryngoscope required a longer period of time (Kim et al., 2008). In another study, Miller laryngoscope and Truview EVO2TM videolaryngoscope were used for intubation in 50 pediatric patients aged 2-8. The mean duration of intubation was recorded as 6.36 sec in Miller group and 13.8 sec in Truview EVO2TM group. They concluded that Truview EVO2TM improved the laryngoscopic glottic image, but required longer intubation times (İnal et al., 2010). In the other study Miller laryngoscope and the Truview EVO2TM videolaryngoscope were compared in 60 newborn and infants. They reported that the time of intubation was 18.18 sec in the Truview EVO2TM group and 16.30 in the Miller group (Singh et al., 2009). Macnair compared direct laryngoscopy and the Berci-Kaplan videolaryngoscope for airway management in 60 children aged 2-16 years. Intubation times were recorded as 16 (14-20) sec for the direct laryngoscopy group and 22.5 (17.8-35) sec for the videolaryngoscopy group, and the duration of intubation was found to be significantly higher in the videolaryngoscopy group (Macnair et al., 2009) In our study, we found that VL prolonged the duration of intubation, consistent with other studies in adult and pediatric patients. It is thought that this result was caused by the difficulty in guiding the tube by watching on the screen during the attempt of intubation with VL. İnal observed the heart rate changes before and after laryngoscopy in their study and found that heart rate changes in the Miller laryngoscope group were significantly lower than in the Truview videolaryngoscope group. They argued that this was due to the longer duration of intubation with Truview. Moreover, in that study, they found that the change in mean arterial pressure was similar in both groups (İnal et al., 2010). In the other study the changes in hemodynamic parameters were recorded in 200 patients aged 20-50 years using a Trueview videolaryngoscope or a Macintosh laryngoscope. Hemodynamic changes were similar between the groups (Timanaykar et al., 2011). Xue found no significant difference between two groups in terms of hemodynamic response to intubation in the study of Glidescope videolaryngoscope and Macintosh laryngoscopy (Xue et al., 2007). Nishikawa compared the effect of videolaryngoscopy and Macintosh laryngoscope on hemodynamic parameters. In the Macintosh group, they found the systolic blood pressure and heart rate at a significantly higher level (Nishikawa et al., 2009).

There was no significant difference between the groups when HR values were compared in our study. However, in the videolaryngoscopy group, SAD, DAB and OAB values were found to be statistically significantly higher at the initial measurements after intubation. It was thought that the reason for this was due to the lack of experience of the practitioner in using the videolaryngoscope.

In our study, ETCO2 values were also monitored after intubation in both groups. ETCO2 values were higher in the videolaryngoscopy group than in the direct laryngoscopy group. However, although there was statistical difference, this was not considered to be clinically significant because the values of ETCO2 did not reach very high values in the videolaryngoscopy group.

Barak compared Truview videolaryngoscopy and Macintosh laryngoscopy complications in 170 patients who were planned to undergo general anesthesia and found no significant difference in terms of dental injury and postoperative stridor. However, during the intubation period, soft palate injuries and lip bleeding were found to be significant in the Macintosh group. They attributed this to the ease of use of the videolaryngoscope, the lesser exertion of force during use and the practitioner's experience (Barak et al., 2007).

In our study, we did not encounter traumatic complications due to intubation in either group. It is thought that mechanical traumatic complications were not encountered due to conduct of the intubation process by watching on the screen, ease of use of the videolaryngoscope and its better image-rendering. In our age group, Truview videolaryngoscopy did not provide an advantage over intubation success in cases with no expected intubation difficulty in the preoperative evaluations. To the contrary, it was observed to prolong the duration of intubation because of the need for good hand-eye coordination compared to direct laryngoscopy.

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