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Comparing the usefulness of VividTrac and classic Macintosh laryngoscope in intubation in pediatric patients with cleft palate

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Abstract

Background Surgical repair for pediatric patients with cleft palate is performed under general anesthesia requiring endotracheal intubation. However, intubating these cases is usually difficult because of the cleft itself and associated airway abnormalities. VividTrac, a video laryngoscopy that could provide a real-time picture of the glottic area, could be helpful in these cases.

Methods We conducted the current prospective investigation to compare VividTrac and conventional Macintosh laryngoscope in intubating pediatric patients with cleft palate.

Results All patient demographics did not express significant differences between the two groups. The number of trials and the first trial success rate were in favor of group L. The former had mean values of 1.28 and 1.05, while the latter occurred in 81.4% and 97.7% of patients in groups L and V, respectively. Group V showed a significant increase in the time interval passing between mouth opening and connecting the tube with the ventilator.

Nonetheless, the difficulty of intubation was increased in group L. The need for cricoid pressure and tube introducer was increased in group L.

Conclusions VividTrac laryngoscope could be a valid and more suitable option for intubation in pediatric patients with cleft palate. Compared to the conventional laryngoscope, it has a higher success rate, lower attempt number, and lower need for assisting maneuvers.

Keywords VividTrac, Macintosh laryngoscopy, Intubation, Cleft palate

Background

The conventional Macintosh laryngoscopy is still considered the main tool for securing endotracheal tubes during general anesthesia (Ecker et al. 2021). Nevertheless, it is necessary to obtain a correct alignment of the oropharyngeal-laryngeal axis for proper visualization of the glottic region when using that tool (Myatra 2019; Mulcaster et al. 2003).

In the recent era, video-assisted laryngoscopy has been introduced, and it gained wide acceptance among anesthesiologists, as it makes the process of intubation easier by overcoming the problem of alignment (Liao et al. 2018; Serkan et al. 2021). This new generation of devices either depends on fiber optic or video camera technologies which helps to provide a real-time photo of the intubation process (Berkow et al. 2018). This, in turn, would

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help to decrease intubation attempts, intubation time, and intubation-associated complications in both operative and intensive care settings (Nouruzi-Sedeh et al. 2009; Doherty et al. 2009).

VividTrac is a video laryngoscopy in which the image is displayed on a nearby connected device (like a tablet or laptop). This laryngoscope has a USB cable that provides it with a power supply from the USB port of the connected device. It also has a special track for inserting the endotracheal tube. As reported by the manufacturers, the working anesthesiologist does not need the head tilt for tube insertion, as the device provides a clear, detailed, and wide real-time photo of the glottic area (Cierniak et al. 2016; Keresztes et al. 2021). Although it is designed to be disposable in the clinical setting, it has the advantage of having the widest visual field along with its strong illumination (Cierniak et al. 2016).

Performing intubation for pediatric patients with cleft palate is a common problem faced by anesthesiologists. This is noted when the defect is especially on the right side, as the laryngoscope blade frequently falls into the cleft region (Bunsangjaroen et al. 2015; Denning et al. 2021). Multiple methods have been recommended to face this problem, including placement of gauze in the defect, external laryngeal manipulation, use of laryngoscopy with straight blades, or application of the lateral or molar approaches (Gunawardana 1996).

With the use of VividTrac in such patients, along with the previously reported benefits, it will document a clear photo of the state of the oral roof following defect closure (Cierniak et al. 2016). Although the VividTrac laryngoscopy has been introduced into the anesthetic field for more than three years, its application is an alternative to the conventional laryngoscopy for intubating the pediatric population with oral congenital anomalies. Therefore, we conducted the current study to compare the VividTrac and conventional Macintosh laryngoscope regarding the degree of glottic area exposure and success of intubation in pediatric patients diagnosed with cleft palate.

Methods

After gaining ethical approval from the local ethical and scientific committee of our university (IRB), R.16.03.1254 (2016), this prospective randomized comparative study was conducted at the Anesthesiology Department of Mansoura University Children Hospital (MUCH) during the period between July 2016 and December 2021. This study adhere to CONSORT guidelines.

We designed this investigation for the pediatric population aged between one and three years, diagnosed with cleft palate and scheduled for surgical repair under general anesthesia in the same hospital. We excluded patients whose age was beyond the previous values and who had upper airway obstruction during the examination.

Sample size calculation

We used the PASS software program for windows 2017. We depended on the data retrieved from a pilot study conducted on ten patients at our hospitals, considering the successful intubation rate as our primary outcome. It was 80% and 100% in the conventional and VividTrac groups, respectively. We required sample size of 43 patients in each group to achieve a 90% power and a 0.05 significance level.

Study groups

We included 86 pediatric individuals with American Society of Anesthesiologists (ASA) I and II, aged 6–48 months in this investigation, according to the previous sample size.

Initially, the benefits and possible complications of each intervention were simply explained to their parents (or guardians), followed by informed consent that was signed by both. After that, all participants received routine preoperative care, including proper history taking, physical examination, and routine preoperative laboratory investigations. The degree of the congenital defect involving the lip, palate, and/or uvula was assessed when the patient was standing upright, opening his mouth, and the tongue resting on the mouth floor. The mobility of the neck was also evaluated via the atlantooccipital joint extension test (Fig. 1).

All patients were admitted the night before surgery. On the next morning, before admission to the operative theater, the included participants were randomly assigned using a computer-generated randomization program and sealed closed envelop method into two equal groups; group L included patients who were intubated via the conventional Macintosh laryngoscopy, and group V included an equal number of cases who were intubated with the aid of VividTrac video-assisted laryngoscopy. In both groups, an appropriate-sized endotracheal tube was applied.

In the operative room, basic standard hemodynamic monitoring was established, and an IV cannula was secured in a suitable peripheral vein. All patients were premedicated with intramuscular atropine (0.05 mg/kg), and anesthesia was induced by IV fentanyl (1 μg/kg) and IV propofol (1 mg/kg), in addition to IV rocuronium bromide (0.9 mg/kg). The first intubation attempt was done one and half a minute following rocuronium. The degree of glottis exposure in the two groups was graded according to the Cormack-Lehane classification system, which is graded from one to four, and the visibility is decreased with higher scores (Cormack and Lehane 1984).

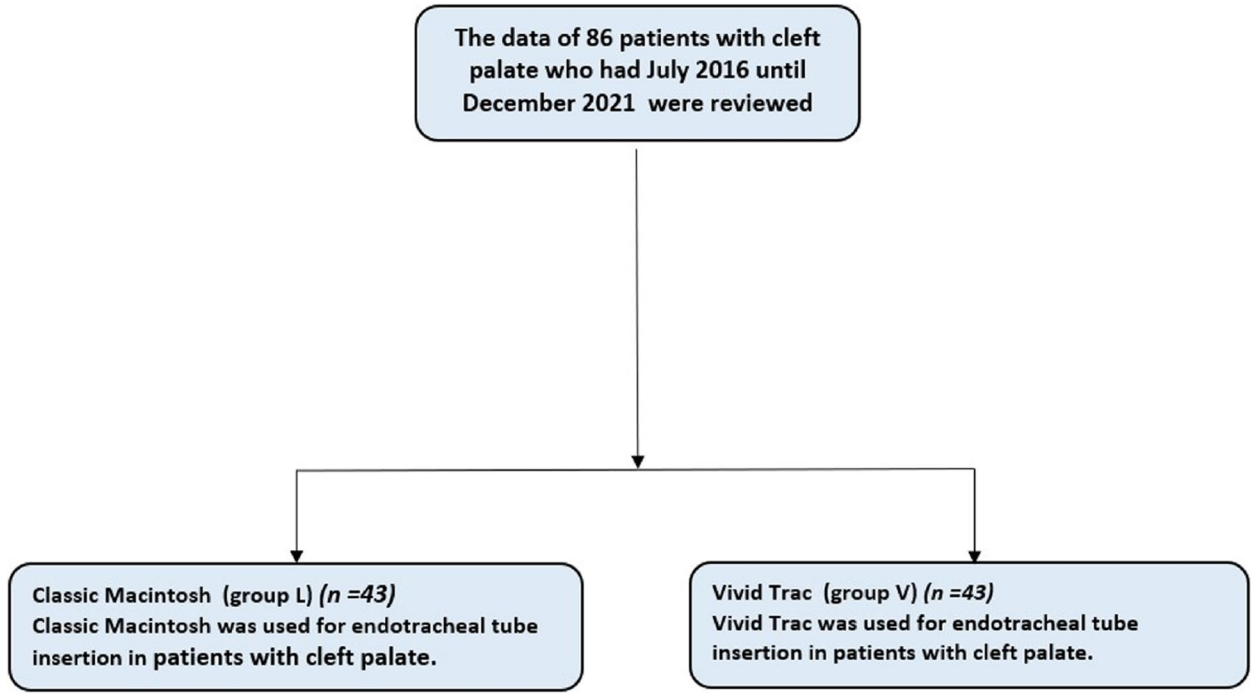

Fig. 1 Patients' group distribution

Outcomes' measurements

The number of intubation attempts, and the need for additional help, like application of cricoid pressure or tube introducer, were noticed and recorded. The time interval between mouth opening and connecting the tube with the ventilator was also calculated and recorded. In cases of intubation failure, the algorithm of "difficult airway society" was followed, whereas if there was difficulty ventilation, the neuromuscular block was reversed by sugammadex (16 mg/kg), the patient was awakened, and then scheduled for another date according to the difficult airway protocol (Mulcaster et al. 2003).

The first intubation success rate was our primary outcome, while secondary ones included the number of attempts, the need for assisting maneuvers, and the time interval between mouth opening and connecting the tube with the ventilator.

Data management and analysis

The collected data was arranged and processed via the SPSS software program (version 25 for MacOS). Categorical data were expressed as frequency and percentage, whereas the normally distributed quantitative data were presented as mean and standard deviation. In comparison between the two groups, the chi-square and Student's *t* tests were used for the two previous data types, respectively. For either test, any *p* value lower than 0.05 was considered statistically significant.

Results

The included pediatric patients had mean ages of 20.09 and 19.74 months in the L and V groups, respectively. Boys represented 51.2% and 37.2% of the included participants in each group, respectively, and the remaining ratios were occupied by girls. As regards the side of the cleft palate, unilateral lesions were detected in 76.7% and 67.4% of patients in the same groups, respectively, whereas bilateral lesions were detected in the remaining patients. All of the previously discussed parameters showed no significant difference between the L and V groups, as illustrated in Table 1.

Table 1 Patient characteristics and the side of cleft palate in the study groups

		Group L ($n=43$)	Group V ($n=43$)	*P*
Age (months)		**20.09 ± 4.064**	**19.74 ± 4.796**	**0.717**
Gender	Male	51.2% (22)	37.2% (16)	0.193
	Female	48.8% (21)	62.8% (27)	
Side	Unilateral	76.7% (33)	67.4% (29)	0.336
	Bilateral	23.3% (10)	32.6% (14)	

The number of blades used was significantly increased in group V (1.63 vs. 1.33 in group L–$p=0.032$). However, the number of trials and first trial success rate were in favor of group L. The former had mean values of 1.28 and 1.05, while the latter occurred in 81.4% and 97.7% of patients in groups L and V, respectively.

Group V showed a significant increase in the time interval passing between mouth opening and connecting the tube with the ventilator (57.33 vs. 49.77 s in group L – $p=0.04$). Nonetheless, the difficulty of intubation, measured by the Cormack-Lehane classification system, was increased in group L ($p=0.045$). The need for cricoid pressure and tube introducer was increased in group L. The former was needed in 25.6% and 7% of patients, whereas the latter was needed in 9.3% and 0% of patients in groups L and V, respectively. Table 2 summarizes the previous data.

Discussion

For most anesthetists, the anesthetic procedure for patients with cleft lip or palate is quite challenging (Akitoye et al. 2018). Difficult intubation is the main concern in these challenges, especially at this young age. Along with the cleft itself, the airway might also have disturbed anatomy or other malformation that restricts easy intubation (Liau et al. 2010; Abdelhameed et al. 2021).

We conducted the current investigation to compare VividTrac and conventional Macintosh laryngoscope in intubating pediatric patients with cleft palate. To the best of our knowledge, this is the first study to assess this special type of video laryngoscope in such cases, and that poses an advantageous point in favor of our investigation. Despite that, other types of video-assisted laryngoscopes were previously investigated and compared to conventional ones.

On the assessment of preprocedural variables, no significant statistical differences were noticed between our two groups. This has two advantages. It denotes our proper randomization applied in this study. Additionally, this should wipe out any bias skewing our findings in favor of one group rather than the other.

In our study, we noted a significant increase in the success rate of VividTrac regarding intubation from the first trial (97.7% vs. 81.4% in the conventional laryngoscope – $p=0.014$).

Our reported success range for the VividTrac lies within the range of intubation success in difficult cases reported in the literature, which ranges between 72 and 99% (Asai et al. 2009; Aziz et al. 2011; Jungbauer et al. 2009; Shippey et al. 2007).

Another recent study also confirmed the upper hand of the video-assisted laryngoscope in cleft lip and palate cases. First-time intubation was achieved in all patients performed by the video technique, compared to 96% in the conventional group (Ray et al. 2021). Moreover, in another study handling the same idea in the adult population with predicted difficult airways, Aziz et al. reported that the overall success rate was 93% and 84% in the video-assisted and conventional laryngoscope, respectively, with a significant rise in the video-assisted one ($p=0.026$) (Aziz et al. 2012).

Furthermore, in another study that evaluated another video-assisted laryngoscope (GlideScope), although the authors included pediatric cases expected to be difficult at intubation, first-attempt intubation was successful in about 50% of the included cases, and ultimately in 100% of these cases. This indicates its efficacy in difficult cases (Sola et al. 2017).

Although our statistical analysis expressed a marked increase in the time interval between opening the mouth and tube connection to the ventilator,

Table 2 Data related to intubation

		Group L ($n=43$)	Group V ($n=43$)	95% CI/ Odds ratio	*P*
Number of blade insertions		1.33 ± 0.522	1.63 ± 0.691	− 0.56, − 0.04	0.032
Number of trials		1.28 ± 0.666	1.05 ± 0.305	0.01, 0.45	0.016
The first trial success rate		81.4% (35)	97.7% (42)	9.6	0.014
The time between opening the mouth and connecting the tube to the ventilator		49.77 ± 21.574	57.33 ± 21.418	− 16.78, 1.66	0.040
Cormack and Lehane grade	1	41.9% (18)	67.4% (29)	-	0.045
	2	41.9% (18)	30.2% (13)		
	3	11.6% (5)	2.3% (1)		
	4	4.7% (2)	0.0% (0)		
Need for cricoid pressure		25.6% (11	7.0% (3	0.22	0.019
Need for tube introducer		9.3% (4	0.0% (0	2.1	0.041

this difference was clinically irrelevant, as we did not encounter any episodes of desaturation during that increase (average 8 s). This increase could be due to our initial experience with manipulating video-assisted laryngoscopes. Other studies also noted a slight increase in intubation times with video laryngoscopes compared to the traditional ones by a range between three and 16 s (Enomoto et al. 2008; Sun et al. 2005).

Our findings showed that VividTrac was associated with a significant improvement in the Cormack and Lehane grades ($p=0.045$). In the same context, Sola et al. assessed the same perspective but in a different way. Pediatric patients predicted to be difficult at intubation were initially assessed by the conventional laryngoscope, followed by the video-assisted one. The authors noticed a marked improvement in the Cormack and Lehane grades ($p<0.001$) (Sola et al. 2017).

Moreover, Serkan et al. noted a significant improvement in the glottic view and intubation scores when applying the video-assisted laryngoscope versus the direct one. They conducted their study on pediatric patients admitted to the ICU unit and requiring intubation (Serkan et al. 2021). Aziz et al. also confirmed the previous findings (Aziz et al. 2012).

In contrast to the previous findings, the intubation difficulty sore did not express any significant differences between the conventional and video-assisted laryngoscope approaches in the study of Ray et al. (Ray et al. 2021). Differences could be attributed to different experiences or case selection.

In the current study, we noted a significant decline in the need for cricoid pressure and tube introducer in the VividTrac group. The superior and wider view provided by the video-laryngoscope could explain this finding. Other multiple studies have demonstrated a decrease in optimization maneuvers with video-assisted laryngoscopes (Maharaj et al. 2008; Malik et al. 2008, 2009). On the other hand, another study reported a higher need for laryngeal pressure in the two groups. It was required in 30% and 36.67% of cases in the direct and video-assisted laryngoscope groups, respectively, and that revealed no significant differences between the two approaches (Ray et al. 2021). The difference in the field of view between different video-laryngoscope could elucidate that heterogenicity.

Limitations

The main limitation of this study was the small sample size that was collected from a single pediatric center is the main one. Thus, it is encouraged to conduct more studies, including more cases regarding that perspective.

Conclusions

VividTrac laryngoscope could be a valid and more suitable option for intubation in pediatric patients with cleft palate. Compared to the conventional laryngoscope, it has a higher success rate, lower attempt number, and lower need for assisting maneuvers.

Abbreviations

ASA American Society of Anesthesiologists
ICU Intensive care unit

Acknowledgements

Not applicable.

Authors' contributions

H.I.T. designed the study, revised literature, performed the analysis followed the patients, measured objective pain score, and wrote the manuscript. T.H.R. designed the study, performed the analysis, and wrote and critically revised the manuscript. M.E.E. followed the patients, measured, and collected demographic data pre and postoperative. A.M.F. followed the patients, measured, and collected demographic data pre and postoperative. M.S.E. measured and collected demographic data preoperative, intraoperative, and post-operative data. All authors read and approved the final version of the manuscript. S.I.E. revised literature and performed the analysis. H.E.S. revised literature, followed the patients, measured, and collected demographic data preoperative, intraoperative, and post-operative data and performed the intubation. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

After receiving approval from Mansoura University, Faculty of Medicine, Institutional research board (IRB), R.16.03.1254 (2016), and obtaining written informed consent to participate in the study, which was provided by all participant' parents or legal guardian, the interventional and randomized trial was conducted in the Mansoura University Children Hospital

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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