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USB-ENDOSCOPE LARYNGOSCOPE IS AS EFFECTIVE AS VIDEO LARYNGOSCOPE IN DIFFICULT INTUBATION

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ABSTRACT

BACKGROUND: Video laryngoscopy (VL) has recently been put into clinical use to minimize the limitations of direct laryngoscopy and assist physicians interested in airway management. However, the high cost is the biggest constraint especially in countries with limited resources. To lower the cost, a custom-made VL obtained by attaching a USB-endoscope camera ($8.5) to the Macintosh laryngoscope (USB-L) can be used.

MATERIAL AND METHODS: All intubations were performed in a difficult intubation model. Intubations were carried out by two emergency physicians. A Glidescope as a VL and a custom-made USB-L were used. In addition to these devices, one bougie to facilitate the advancement of the tube was used. The total intubation time was evaluated.

RESULTS: Correct tube placement for both operators was 100% for both devices. A difference between the operators in the duration of intubations could not be found. Also, there is no difference in the duration of intubations between the devices for both operators.

CONCLUSION: It was concluded that the USB-L and VL are not statistically different in terms of intubation time in the difficult intubation model using bougie. For countries with limited resources, the low-cost USB-L has come to the forefront due to the high cost of VL and difficulty of access.

KEY WORDS: difficult intubation, video laryngoscope, bougie, mannequin, intubation time

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INTRODUCTION

Direct laryngoscopy is a widely used method for endotracheal intubation in the emergency department. Video laryngoscopy has recently been put into clinical use to minimize the limitations of direct laryngoscopy especially in difficult intubation [1, 2]. However, the high cost is the biggest constraint to this method's use, especially in emergency departments of countries with limited resources [3]. To overcome this situation, it has been suggested that a custom-made video laryngoscope obtained by attaching a universal serial bus (USB) endoscope camera to the Macintosh laryngoscope can be used for the same purpose [4]. It has been reported that this custom-made device (the USB-L) can assist in experimental studies and education of medical, paramedic students, and emergency medicine residents [5].

A study was carried out in India on the use of a custom-made laryngoscope in a clinical setting. The authors intubated half of 40 patients with similar age, gender, physical characteristics, American Society of Anesthesiologists, and Mallampati score with a Miller direct laryngoscope and bougie. The other half were intubated with a USB-L. There was no difference between the groups in terms of heart rate and mean arterial pressure after intubation.

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Although the mean of the total intubation times was shorter using the USB-L, there was no statistically significant difference between the two groups ($p = 0.712$) [6].

It is shown that a USB-L provides similar vision, clarity, and ease of intubation to that of expensive video laryngoscopes [7]. The trials carried out by clinicians with this device will provide an idea for companies that can produce low-cost devices that can be connected to smartphones. In addition, during the COVID-19 pandemic, that custom-made devices like the USB-L will help protect healthcare professionals in high aerosol-forming processes in difficult intubation. However, there is no proof that USB-L is effective as a video laryngoscope in difficult intubation.

This study aimed to evaluate custom-made USB-endoscope laryngoscope effectiveness in difficult intubation compared to a well-known video laryngoscope.

MATERIAL AND METHODS

All intubations were performed using the AirSim Advance Bronchi X intubation simulator model (mannequin) (TruCorp, Armagh, N. Ireland) and a difficult airway. Difficult AirSim Airway featured enlarged tongue oedema with an elongated notched epiglottis.

As the low-cost USB endoscope ($8.5), a 5 mm diameter was used, waterproof, illuminated device compatible with Android, 480p and 0.3-megapixel resolution. Similar to previous studies, the USB endoscope was attached approximately 40 mm behind the tip of the traditional Macintosh direct laryngoscope (Fig. 2). The visual orientation was checked before attaching as described previously [5]. The USB camera was linked via a USB cable to the laptop and a micro-USB cable to the mobile device. The CameraFi (Vault Micro Inc., Seoul, Korea) software on the Android phone was used. Before each intubation, the USB camera and the cables were cleaned with alcohol-based medical device surface disinfectants.

We used a Glidescope-Titanium MAC T4 with a 60° hyper angulated blade (Verathon, USA) as a reusable video laryngoscope. In addition to these devices, one bougie in both methods was used to facilitate the advancement of the tube.

Intubations were carried out by two emergency physicians experienced in intubation. The order of difficult intubation with USB or video laryngoscope was randomized with rolling dice.

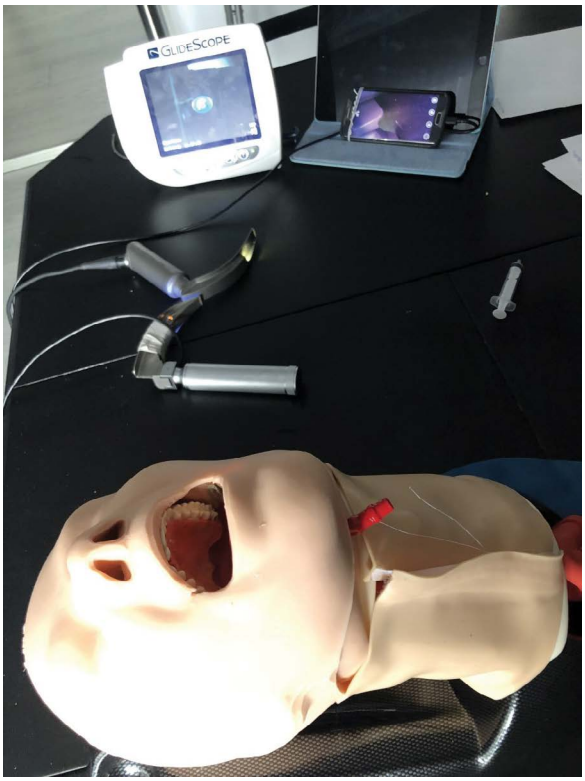

FIGURE 1. Demonstration of USB-L and video laryngoscope

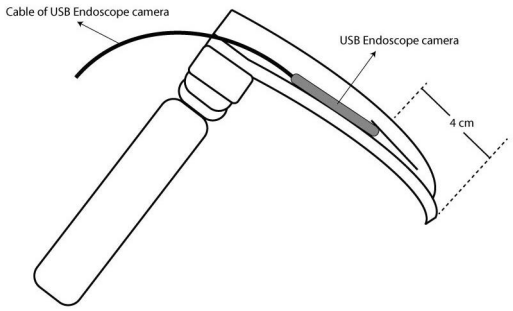

FIGURE 2. Schematic illustration of USB-L

In the study, the total intubation time as the time from entering the laryngoscope blade in the mouth of the mannequin to placing the tube was evaluated. An emergency medicine professor checked all the processing steps as an independent observer.

Statistical Analysis

While calculating the sample size, Cohen's medium effect size was used because no predictions about the parameters to be investigated could be made, as no similar studies in the literature were found. Accordingly, as a result of the power analysis with G*

Power, when the effect width d = 0.50 was taken, it was calculated that a total of at least 102 intubations would provide 80% test power and a 95% confidence level. Since two operators would intubate four times with two devices, it was found that each operator must perform at least 26 intubations with each device. Hereupon, each operator made 27 intubations.

Descriptive statistics like the mean were given [standard deviation (SD)], and intubation times were compared using a paired samples *t-test*. A p-value under 0.05 was accepted to be statistically significant. The statistical analysis using STATA 15.1 (Stata Corp., Collage Station, TX, USA) software was conducted.

RESULTS

The tracheal tube placement and glottic visualization succeeded in all intubations of the two operators for both devices. Operator 1 intubated the difficult intubation model in 26.97 ± 26.98 seconds via video laryngoscope and 20.10 ± 6.53 via USB-endoscope laryngoscope. Besides, operator 2 intubated the model in 22.83 ± 10.52 seconds via video laryngoscope and 18.96 ± 6.11 via USB-endoscope laryngoscope. Table 1 shows the number of intubation, the mean intubation times and standard deviation for Operator 1 and Operator 2.

In the comparison of intubation times of operator 1 and operator 2, both the video laryngoscope intubation time (p = 0.496) and the USB-endoscope laryngoscope intubation time (p = 0.542) was not different. Also, the intubation time via video laryngoscope or USB-endoscope laryngoscope was not different for both operators (Tab. 2).

Table 1. Mean intubation times of the two operators in seconds

	Number of intubation	Number of successful intubation	Mean ± SD (seconds)
Op.1 VL	27	27	26.97 ± 26.98
Op.1 USB-L	27	27	20.10 ± 6.53
Op.2 VL	27	27	22.83 ± 10.52
Op. 2 USB-L	27	27	18.96 ± 6.11

SD — Standard deviation; VL — video laryngoscope; USB-L — USB-endoscope laryngoscope

Table 2. Comparison of means of intubation times by Paired samples *t*-test

	Paired differences		p value
	Diff Mean ± SD	95% CIs of the difference	
Op. 1- VL vs. Op. 1- USB-L	6.84 ± 5.14	-3.72–17.41	0.195
Op. 2- VL vs. Op. 2- USB-L	3.86 ± 2.28	-0.82–8.55	0.102
Op. 1- VL vs. Op. 2- VL	4.11 ± 5.96	-8.14–16.37	0.496
Op. 1- USB-L vs. Op. 2- USB-L	1.13 ± 1.84	-2.64–4.91	0.542

Op. — Operator; CI — Confidence interval; SD — Standard deviation; VL — video laryngoscope; USB-L — USB-endoscope laryngoscope

DISCUSSION

This study could not find a statistically significant difference between the duration of intubations performed by both operators with different devices (video laryngoscope vs. USB-L by operator 1 and 2) individually. A statistically significant difference was not found between the duration of intubations performed by both operators using the same devices (video laryngoscope by operator 1 and 2 & USB-L by operator 1 and 2), respectively. Based on this, it was concluded that the USB-L and video laryngoscope are not statistically different in terms of intubation time in the difficult intubation model using bougie.

Airway interventions are needed in these patients upon the development of the severe acute respiratory syndrome. However, tracheal intubation is a very high-risk method for airway management in these cases due to high levels of SARS-CoV-2 virus load in sputum and upper airway secretions. Therefore, appropriate precautions must be taken to keep personnel safe in the foreground. Although systematic research on healthcare workers' risk of infection is based on limited literature, it has again become prominent with COVID19 [8].

Guidelines recommend the use of an aerosol box covering a patient's head during tracheal intubation in the COVID-19 era. However, intubation can be challenging with protective equipment such as an aerosol box, eye goggles and face shield. Several expert recommendations have been made for the use of video laryngoscopes while intubating these patients so that the time required for intubation is minimized [9–12]. Currently, there are various video laryngoscopes in the market and it has been shown

that they perform differently under these protective measures [13–14]. A study using stimulation of tracheal intubation in a patient with stimulation of COVID-19 showed prominent differences between six video laryngoscopes in patients with inhibited neck movement and limited mouth opening [13]. In a case series including adult patients that intubation with a Macintosh laryngoscope had been difficult, intubation with a video laryngoscope was successful in 290 of 293 patients [15]. Some other randomized, controlled studies comparing different video laryngoscopes have shown a higher success rate of intubation using the video laryngoscopes when compared to Macintosh laryngoscope [16–18]. It is now clear that video laryngoscopes increase the success rate of tracheal intubation with difficult airways.

In a previous study, the success rate of tracheal intubation in the first attempt was found to be around 80%, and the risk of infection of health personnel was said to increase during multiple airway manipulations. For this reason, it is recommended to use airway techniques, such as a video laryngoscope, that are reliable and maximize success in the first attempt [8]. This study compared video laryngoscopy and USB-L. The placement of the tube took place in both methods with 100% accuracy. The authors believe that no significant difference between intubation times was detected because of the similar view and quality of USB-L and video laryngoscopy in intubation.

A study comparing normal and difficult airways with inexperienced operators evaluated the time and rate of successful intubation, the best view of the glottis, oesophageal intubation, dental trauma, and user satisfaction. As a result of this study, intubation-related times, glottis appearance, and operator satisfaction were found to be significantly higher in commercial video laryngoscopes. In contrast, custom-made video laryngoscopy performance was found to be similar to that of a Macintosh direct laryngoscope. As a result, it was found that video laryngoscopes are superior to Macintosh direct laryngoscopes in both normal and difficult airway scenarios for inexperienced users [19]. This study, due to the similar experience of both operators, did not present a significant difference between intubation times in similar devices (video laryngoscopy by operator 1 and 2 & USB-L by operator 1 and 2).

Another study showed that the duration of intubation with the USB-L was shorter than that of the direct laryngoscope similar to this study. The duration of successful tracheal intubation was 26.92 ± 5.03 seconds in the USB-L group and 40.64 ± 5.7 seconds in the direct laryngoscopy group. This difference was considered statistically significant ($p < 0.001$). The authors also reported that the image quality of the USB-L may decrease due to condensation on the lens and secretion in the oral cavity [20]. Since the study was carried out on a mannequin, no imaging problems related to fogging on the lens and secretion were encountered.

In another study which investigated the success of USB-L in 50 elective surgery intubation, external laryngeal manipulation improved vision in 44% of intubations. Of the cases, 20% were intubated with the help of bougie, and the remaining cases were intubated directly with the endotracheal tube. The success rate on the first attempt of intubation was 82%. The remaining 18% were intubated on the second attempt. For 64% of the intubations, the operators reported that intubation was easy and confident [21]. In this study, both operators used USB-L with bougie for all difficult intubations. In no attempts were the endotracheal tubes located in the oesophagus. Furthermore, no difficulty was encountered in guiding and advancing the endotracheal tube in the use of video laryngoscopes in this method. The bougie enabled the tube to move easily through the airway. Unlike in that study, external laryngeal manipulation was not needed, as intubations were not performed on the patients.

In the COVID-19 pandemic, it has been reported that the use of video laryngoscopy is a safer method for healthcare workers, as tracheal intubations are considered very high risk in terms of contamination [8]. During the pandemic, the use of low-cost devices that will be attached to the USB camera instead of a direct laryngoscope has also come into question, especially in a limited resource setting.

CONCLUSIONS

The authors concluded that the USB-L and video laryngoscope are not statistically different in terms of intubation time in the difficult intubation model using bougie. For countries with limited resources, the low-cost USB-L has come to the forefront due to the high cost of video laryngoscopes and the difficulty of access.

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