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Comparison of Video Laryngoscopy and Direct Laryngoscopy in the Success of Intubation Performed by Novice Personnel in Patients with Cervical Immobilization: A Manikin Study

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Abstract

Introduction: Pre-hospital intubation is a challenging but essential intervention. During intubation, it is difficult to identify vocal cords when using a cervical collar and trauma board. Therefore, the success rate of intubation by paramedics decreases in trauma patients. Video laryngoscopy increases intubation success rate and has been recommended for difficult airways in studies.

Objective: In this study, we compared the intubation success rates when using a video laryngoscope and a direct laryngoscope in a manikin with simulated cervical immobilization.

Methods: In this cross-sectional study, the manikin's neck collar and spine board created a complicated airway model with cervical immobilization. Inexperienced paramedic students tried intubation with both methods, and their trial periods were recorded. Students answered a question evaluating the convenience of the procedure for both methods after the trial.

Results: In this study, 83 volunteers, who were first-year and second-year paramedics, participated; 32 (38.6%) of the volunteers were first-year students, while 51 (61.4%) were second-year students. All volunteers had previous intubation experience with direct laryngoscopy, but not with video laryngoscopy. There was a statistically significant difference in the first-attempt success rates of the procedure between the groups in favor of video laryngoscope (p=0.022). Note that there was no significant difference between the groups in terms of first attempt durations (p=0.337).

Conclusion: Video laryngoscopy in airway management can increase the success rate of first-attempt intubation by inexperienced pre-hospital healthcare personnel.

Key words: Airway Management; Emergency Medical Technicians; Immobilization; Intratracheal Intubation; Neck; Laryngoscopes; Video Laryngoscopy

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INTRODUCTION

Endotracheal intubation (ETI) plays a crucial role in pre-hospital airway management, and there are various techniques in this regard (1-4). Studies conducted on trauma patients have emphasized the importance of ETI in terms of mortality and morbidity (5, 6). The success rate of ETI by pre-hospital healthcare professionals other than physicians is 87.9%; however, this rate decreases to 69.8% in trauma cases (7). Nevertheless, in this group of patients, the first-attempt success of paramedics remained at 56% (8). Reyhan et al., in their 2017 study, concluded that application of cervical collar and spinal board hinder the laryngeal view and reduce intubation success (9). The Difficult Airway Society emphasizes that selecting a proper laryngoscope improves ETI success, and video laryngoscopy is used as the first choice by some anesthesiologists in such situations. Video laryngoscopy has become an alternative to routine airway management techniques since 2009 and can be preferred, particularly in the presence of a difficult airway and for training of medical personnel (10-12). In pre-hospital studies, video laryngoscopy showed increase ETI success rate during transport in complicated airway models and trauma patients. These studies tested the success of ETI by experienced paramedics, nurses, and emergency medicine physicians (1, 13-15). Pre-hospital intubation with trauma board and cervical collar is mainly performed by paramedics. Studies evaluating ETI success rates by paramedics mostly evaluated a direct laryngoscope, but their experience with a video laryngoscope was minimal

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(16, 17). This study aimed to compare the success rate of ETI between video laryngoscopy and direct laryngoscopy performed by novice paramedic students inexperienced in managing the airway on a manikin with simulated cervical immobilization and trauma board.

Methods

Study design and participants

This study had a cross-sectional design conducted in Turkey. After obtaining approval from the local ethics committee (18-2 / 37), the researchers explained the study to paramedic students, and those who volunteered participated in the study. In terms of intubation skills, novice paramedic students were employed because they had neither encountered patients or manikins with cervical collars, nor performed video laryngoscopy before.

Preparation

The researchers described 30 minutes didactic PowerPoint presentations with standard intubation stages. For this, 15 minutes submitted a video in reproduction with the same working equipment. The researchers explained the steps, flow charts, and study details in this informative preliminary meeting. At this stage, they answer questions about the study.

Equipment

Ambu® airway manikin and Ambu® cervical collar, endotracheal tube numbered 7.5, Macintosh 4 blade (MAC4), and C-MAC® D blade (Karl Storz, Tuttlingen, Germany) video laryngoscope were used. A lubricant was applied to the endotracheal tube. The airway manikin was in supine position on the trauma board on the stretcher and was wearing a neck collar (Figure 1).

Evaluation of intubation skills

The airway manikin was ready on a standard trauma board with a collar applied. The volunteers were called from the waiting area by their previously assigned case report numbers. We randomized the volunteers into two equal groups to determine which method they used first in order to avoid bias. According to the previously prepared randomization scheme, either a video laryngoscope or Macintosh blade was given to the volunteers. At the first attempt with the Macintosh, the chronometer started when the volunteer had the endotracheal tube ready and said, "I am ready". The chronometer was then stopped when the practitioner said, "I did it". The tube was ventilated with a balloon mask, confirming the site of intubation. In cases of incorrect intubation, the practitioners could have two more attempts. Immediately after the success in the first method of intubation, the other method was attempted using the same timing method and possible number of attempts to succeed and method of placement confirmation.

Figure 1: Used airway manikin with cervical collar placed on a spinal board in current study

All volunteers attempted both methods. For both methods, the researchers recorded whether an intubation was successful, number of attempts, and the total duration of the procedure. Volunteer's withdrawal was considered unsuccessful. There was no time limit. At the end of the intubation procedures, paramedic students rated both attempts on a visual analog scale (0: most difficult – 10: easiest). Those who failed in any of the procedures performed with video laryngoscopy or direct laryngoscopy were asked to explain the cause of their failure based on five criteria (a-Practice; b-Problem with the view; c-Movement restriction; d-Lack of experience; and e-Other)

Statistical analysis

The demographic data of the volunteers including age, gender, type of high school attended, and intubation experience was recorded. Comparison of intubation success rates between direct and video laryngoscopy was performed using a paired t-test for data with normal distribution in groups with dependent variables. Wilcoxon's test was performed in groups that did not conform to the normal distribution. Data were evaluated with means and standard deviations, medians with interquartile ranges. Volunteers were asked to evaluate convenience on the visual analog scale. For each method, the medians of data were identified. These medians were evaluated using Wilcoxon's test, using IBM SPSS Statistics 25.0 software (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). The level of significance was set at 0.05 in all analyses.

Results

There were 137 students in the first and second year of Medical Technology Vocational Training School Paramedic Program. Moreover, 83 students

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volunteered to participate in the study. Fifty-four (65.1%) of the volunteers participating in the study were female, and 29 (34.9%) were male. Their mean age was 20±1.5 (18-27) years. Moreover, 32 of the volunteers (38.6%) were first-year, and 51 (61.4%) were second-year students. Health vocational high school graduates (70 people (84.3%)) were in the majority. All the volunteers had already performed intubation: 56 volunteers (67.5%) had attempted intubation on a manikin, 13 (15.7%) volunteers on actual patients, and 13 (15.7%) volunteers on both manikin and actual patients, but none had any experience on subjects with cervical collar. None of the volunteers had previously performed intubation using a video laryngoscope.

Table 1 presents data on the total success rates, the total duration of the procedure, and the success status, based on the number of attempts by the volunteers. While 62 (74.7%) volunteers successfully intubated the manikin using direct laryngoscopy, 63 (75.9%) people were successful using video laryngoscopy. Accordingly, there was no statistically significant difference in terms of successful intubation rates between the two methods (p=0.835). However, the times taken to perform a successful intubation were 36.11 (95%CI: 15.64-61.74) seconds using direct laryngoscopy and 20.13 (95%CI: 13.36-48.43) seconds using video laryngoscopy. There was a significant difference in terms of total procedure times (p=0.046). When comparing the success rates of practitioners on their first attempt to perform intubation, 30 volunteers were successful using direct laryngoscopy, and 45 volunteers were successful using video laryngoscopy, which was statistically significant (p=0.022).

Volunteers participating in the study evaluated the convenience of the procedure on a visual analog scale. The median (IQR) response for the whole

Table 1: Comparison of intubation success rates and time taken for intubation between direct laryngoscopy and video laryngoscopy

Variable	Direct laryngoscopy		Video laryngoscopy		p-value
	n(%)	%95 CI	n(%)	%95 CI	
Intubation success					
1st Attempt	30 (36.1)	25-47	45 (54.2)	42-65	0.019
2nd Attempt	22 (41.5) n=53	28-55	10 (26.3) n=38	13-43	0.122
3rd Attempt	10 (32.3) n=31	16-51	8(28.6%) n=28	13-48	0.736
Total success rate	62 (74.7)	63-83	63 (75.9)	65-84	0.836

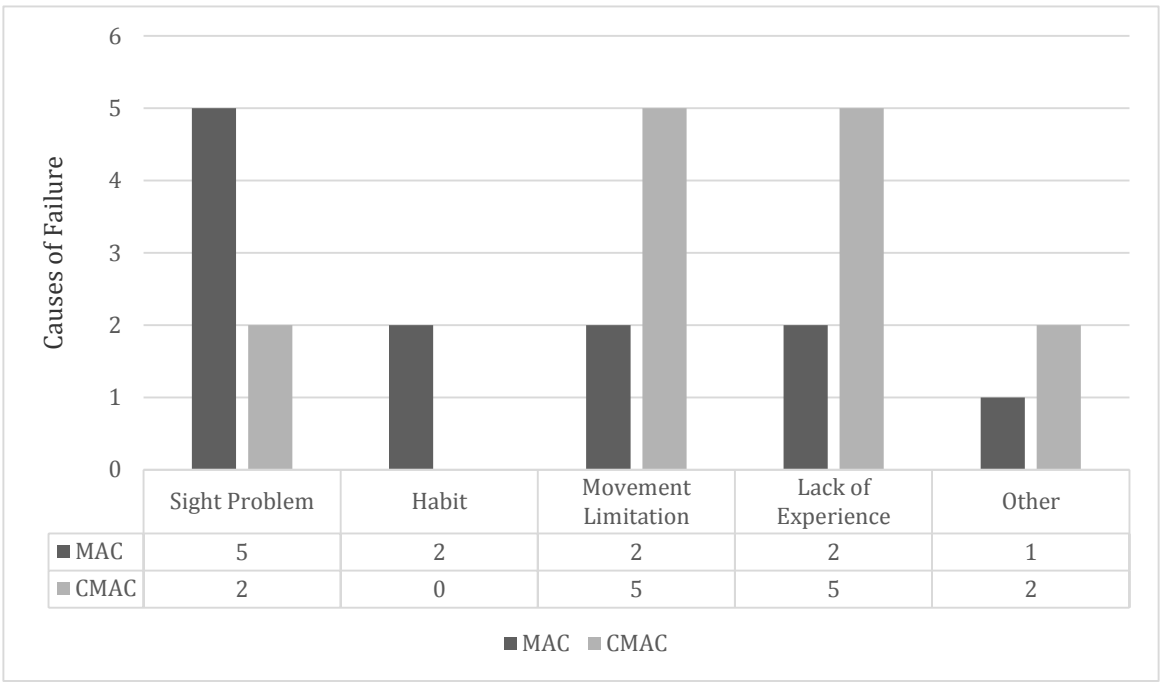

Figure 2: Responses given about the cause of failure by those who failed in one of the methods (MAC: direct laryngoscopy; C-MAC: video laryngoscopy)

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volunteer was 6 (4-8) for direct laryngoscope and 8 (5-9) for video laryngoscope. There was no statistically significant difference between the two methods in terms of convenience of the procedure as rated by the volunteers (p = 0.070).

Twelve of the volunteers achieved success in only one of the two methods. We asked these volunteers why they failed in the method they failed. Table 2 shows the answers they gave to the questions categorized under the five topics. Accordingly, the most common causes mentioned in those who failed using video laryngoscope were limitation of movement and lack of experience; however, the most common reason mentioned for failing using a Macintosh blade was not being able to view the vocal cord.

Discussion

This study compared the ETI success rates of novice paramedic students in direct laryngoscopy and video laryngoscopy on the airway of a mannequin with cervical immobilization. The success rate of the first ETI attempt, which was the primary goal, was higher when using a video laryngoscope; and we found that successful ETI using a video laryngoscope takes a shorter time. There was no significant difference in the responses to questions regarding the convenience of the two methods.

Altun et al. compared direct and video laryngoscopes and reported that video laryngoscopy had a significantly higher ETI success rate, and emphasized that familiarity with the device would increase success (18). Current study also appears to favor video laryngoscopy, as it had achieved more success than direct laryngoscopy even in the first encounter after theoretical training.

There was no difference in total success rate in studies with healthcare professionals who did not have video laryngoscopy experience but had direct laryngoscopy experience (9, 19). Similarly, there was no difference in the total ETI success rate in current study. We believe that, while protecting patients from secondary neurological damage is essential in trauma patients, even if there was no difference between total intubation success rates, the superiority of video laryngoscopy in first-attempt success suggests that it would be more appropriate for use by novice personnel in pre-hospital practice.

In the literature, there was no significant difference between the video laryngoscope and the direct laryngoscope in terms of the time spent by the novice personnel for successful intubation (9). Moreover, in one study, experienced personnel had a longer intubation time using video laryngoscope (17). In contrast, Vedel et al. reported that experienced personnel were more successful in terms of time, even in their first encounter with the video laryngoscope, compared with direct laryngoscopy (20). Also, Ruetzler et al. emphasized in their study that intubation is faster with video laryngoscope (21).

There was no difference between the two methods in terms of convenience assessment by the volunteers. video laryngoscopy was described as easy in practice as one of the video laryngoscope types (17, 18, 22). However, unlike the present study, volunteers with intubation experience were used in those studies.

Limitations

The study might not precisely reflect the success of ETI in actual patients because it is a manikin study. Paramedic students' previous experience with direct laryngoscopes may be a disadvantage for video laryngoscopes. Volunteers finding the video laryngoscope procedure easy may reduce the importance of this limitation. Therefore, comparative studies are required with novice personnel who have received training for video laryngoscopy.

Conclusions

The video laryngoscope increases the rate of success in the first attempt to intubate manikins among healthcare professionals who do not have sufficient experience in the airway management of patients with cervical immobilization. Increasing training with video laryngoscope and experience of novice healthcare professionals can increase the success rates of intubation in the first attempt. The findings of the present study need to be confirmed via studies conducted on actual patients.

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Authors' contribution

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Conflict of interest

The authors declare that there is no conflict of interest.

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