

The Effectiveness of Endoscope Camera in Combination With Modified Standard Laryngoscope in Endotracheal Tube Installation

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ABSTRACT

Background: Emergency is a critical condition which requires accuracy and speed of actions. Intubation is one of the most frequently performed actions in an emergency department. The success of intubation has a significant influence on the success of the emergency department. A number of factors affect the success of intubation, including the technique of mastery of intubation. Laryngoscope is an important supporting instrument for intubation, which therefore requires expertise in its use. This study aimed to determine the effectiveness of a laryngoscope equipped with an endoscope camera. Methods: This study used a post-test only control group design as the experimental design. A total of 30 subjects acted as operators in the trial on intubation mannequins using a direct laryngoscope compared to using a laryngoscope equipped with an endoscope camera. Successful intubation was achieved when the insertion of an endotracheal tube right into the airway resulted in a chest expansion within a maximum of 120 seconds. The significance of the differences in the time and ease of use of video laryngoscopy was analyzed using SPSS version 24.0. Results: A stratified statistical analysis was carried out, starting with the Shapiro Wilk test to determine the normality of data distribution. The test indicated an abnormal distribution, thereby allowing the use of Wilcoxon test to determine the significance of the intubation time. No significant time difference was found in the use of laryngoscope versus laryngoscope equipped with an endoscope camera ($p = 0.811$). However, in the analysis using the Fisher Exact Test ($p = 0.00$) for the ease of use of laryngoscope equipped with an endoscope camera, significant results were obtained. Conclusion : The use of video laryngoscopy is not significant in terms of insertion time, but the ease of use analysis shows significant results.

Keywords: Direct Laryngoscopy, Emergency Department, Intubation, Video Laryngoscopy

1. INTRODUCTION

During an emergency, airway control is an important clinical setting in handling the condition. Intubation is one of the key measures in airway control for emergency patients. Theoretically, the success of intubation is one indicator of successful emergency management. However, the installation of intubation is not as easy as it is imagined, which is evidenced by the fact that approximately 17% to 29% of new intubations are successful only after the second or even third insertion. Based on evidence in practice, multiple failed intubations pose a great risk of complications in the future [1]. Some of the complications that can occur because of more than once attempted intubation include airway damage, tooth decay, brain damage, and cardiopulmonary arrest, and even death can occur when management of airway maintenance, particularly endotracheal intubation, fails. These complications are highly detrimental and endanger the patient's life. Therefore, it is extremely important to avoid a failed intubation [2].

Numerous factors influence the failure of an intubation for the first time. The patient's condition, such as trauma to the face and edema of the tongue and airway, as well as poorly mastered techniques are some examples of these factors. The poorly mastered technique becomes a major challenge for health workers generally due to their inability to see the patient's Plica Vocalis condition even though they have used a laryngoscope as the standard instrument. In Indonesia, the failure of intubation often occurs in the Emergency Unit. Based on the study by Tantri *et al.*, the high failure rate of intubation in the ER results from, among others, the great tribal diversity in Indonesia that can affect the craniofacial structure. Such structural diversity has an effect on the structural description seen, which in turn is linearly related to the success of intubation [2].

Theoretically, a clearer view of the airway is directly proportional to the success of intubation. Therefore, researchers continue to study the development of assistive devices that can facilitate airway assistance, such as laryngoscope. Based on a meta-analysis study conducted by Su *et al.*, the discovery of a laryngoscope device equipped

with a real time video feature has shown different results compared to the standard laryngoscope [3]. It was found in 8 out of the 11 journals analyzed that the epiglottis picture was more clearly visible using video laryngoscopy compared to direct laryngoscopy [4]. Therefore, this study aims to develop the ease of use of video-based laryngoscope technology.

2. METHODS

2.1. Participants of the research

This study was purely experimental research with a Posttest Only Control Group Design aiming to assess the effects of speed and accuracy of intubation using a laryngoscope equipped with an endoscope camera compared to a direct laryngoscope. There were 30 participants as the operators who were assigned to perform intubation using a laryngoscope equipped with an endoscope camera and using a direct laryngoscope on a mannequin. The success of intubation was indicated by the appropriate positioning of the intubation in the airway as evidenced by the expansion of the chest within a maximum of 120 seconds. The research was carried out in the area of Indonesian Islamic University Hospital.

2.2. Ethical Clearance

The ethical clearance was obtained from the Ethics Committee of the Faculty of Medicine of Islamic University of Indonesia as a legal requirement for conducting research.

2.3. Materials

The instruments used in this study consisted of standard laryngoscope, endoscope-camera modified laryngoscope, endotracheal tube, intubation stylet, intubation mannequin, stethoscope, Ambu bag, intubation mask, latex gloves, 10 cc syringe, and scissors. In addition, the materials used comprised lubricating gels and adhesives.

2.4. The process of testing the effectiveness of a modified laryngoscope with an endoscope camera

The research participants were determined among the health personnel at Islamic University of Indonesia Hospital consisting of skilled group and less skilled group. The selection of research participants involved a simple random sampling method to reduce confounding factors related to the mastery of intubation insertion technique. The determination of the number of samples referred to the standard reference source, in which the minimum number of participants was 30 for each treatment intervention, with informed consent collected from the participants.

Meanwhile, the timing was adjusted between the study and the research participants. The instruments were also prepared, consisting of a direct laryngoscope, an innovative laryngoscope, a mannequin as the research object, and a timer. Simultaneous trials of the direct laryngoscope and the innovative laryngoscope were then performed using two mannequin objects with the time recorded according to the

standard procedure for intubation. The time speed confirmation was tested by looking at the 120 second maximum timer while the satisfaction of the instrument was examined at the end of the study using a questionnaire according to the attachment.

2.5. Statistical analysis of the effectiveness of modified laryngoscope with endoscope camera

The data obtained were in the form of numerical data taken from the total number of the subjects who successfully paired the intubation. The data were then analyzed using SPSS statistical software to examine the speed difference between a modified standard laryngoscope and a direct laryngoscope through an Independent Sample T- test with a significance value of $p < 0.05$. Furthermore, the instrument satisfaction analysis was conducted using the Chi-square test based on the data obtained from the questionnaire by calculating and analyzing the number of "yes" and "no" answers. The confounding factors could be minimized through the use of a simple random sampling method and a homogeneous mannequin object.

3. RESULTS

Based on the data collection, a total of 30 participants were obtained with the associated background and overview of the scores shown in Table 1. The samples consisted of medical personnel as the research participants. The treatment trial started after the issuance of ethical clearance from the authorized ethics committee. Based on the results of the study, the participants consisted of 18 (60%) women and 12 (40%) men, and the majority of them were nurses (23 people or 74.2%). The youngest participants were aged 28 years old (5 people or 16.7%) with the highest percentage of the length of work being 12 months (8 people or 26.7%). The average demographic characteristics of the participants are described in Table 1.

Table 1. Characteristics of the Research Participants (n = 30)

Characteristic	Average Score
Gender (male/female)	12/18
Age (years)	32.60 ± 8,058
Length of work (months)	16.53 ± 6.367
Profession (doctor/nurse)	7/23

The mean value was given in detail ± Standard Deviation (SD) from the descriptive analysis by SPSS 24.

Meanwhile, the statistical analysis of the effectiveness of modified laryngoscope was performed in stages using SPSS version 24.0. The significance test aimed to examine the time difference in the intubation using a direct laryngoscope compared to that using laryngoscope equipped with an endoscope camera. The difference in the ease of use between laryngoscope with an endoscope camera and direct laryngoscope was also analyzed. The ease of use served as a parameter of the effectiveness of the laryngoscope equipped with an endoscope camera used in the intubation on a mannequin. The analysis stage began with a data distribution

normality test using Shapiro Wilk, and an insignificant value was obtained (0.00 with $p < 0.05$). The time difference was then examined using the Wilcoxon test, resulting in a value of 0.811 ($P > 0.05$) which indicated no significant time difference between intubation using direct laryngoscope and that using video laryngoscope. Then, the analysis was continued to test the significance of the ease of use of intubation with a video laryngoscope. The Fisher's Exact test was selected for the analysis since the data distribution was abnormal. The results showed a significant value ($p = 0.00$), indicating the ease of using laryngoscope equipped with an endoscope camera as opposed to using a direct laryngoscope.

4. DISCUSSION

Emergency conditions are precarious conditions that require fast and precise handling. Insertion of intubation as one of the actions frequently performed to handle emergency conditions plays an important role. Cierniak *et al.* stated that insertion of intubation is a critical step in supporting the management of emergency conditions. Fast and precise action is needed during intubation, but several factors can affect the effectiveness of intubation, including an under-pressure condition, inexperience, and inadequacy of the existing equipment. In a primary care hospital, intubation is a challenge per se. The vulnerability to the risk of intubation failure should be considered as it is affected by, among others, the lack of a special professional team for intubation and a high proportion of less experienced health personnel [5]. Based on the study results, a composition of health personnel consisting of new doctors and specialists has high potential to increase the success rate of intubation. Even so, not all hospitals have such composition [6].

Supporting equipment is one of the factors and solutions to the problem of installing intubation in the emergency unit [5]. Laryngoscope is one of the supporting instruments commonly used for intubation. The development of this device has been dynamics, but research related to laryngoscope modification to support intubation remain necessary to conduct [6]. Based on the study by Baptize *et al.*, intubation has a significant success rate with the aid of a laryngoscope, but a specific analysis of the effectiveness of both standard and video-based laryngoscopes shows no significant results [7]. A meta-analysis conducted by Savino *et al.* found that the use of varied types of direct or video laryngoscope does not produce a significant difference but has the advantage of being relatively easy, making it recommended for use in primary health services [8].

Some previous literature explained that, in terms of use, a standard laryngoscope is not significantly different from a video-based laryngoscope, but the latter has a higher level of convenience. This is similar to the results of this study of 30 participants in Indonesian Islamic University Hospital consisting of nurses and doctors. The Wilcoxon test showed that the difference in intubation time was not significant, with $p = 0.811$. However, in the ease of association test of video-based laryngoscope, the results were significant with $p = 0.00$.

5. CONCLUSION

Intubation is one of the key actions in handling emergency cases. Using a laryngoscope as an instrument for intubation is not as simple as it looks because it requires mastery of the technique in its application. Therefore, the development of laryngoscope technology continues, and one of the developed devices is a video-based laryngoscope. This research focuses on developing a video-based laryngoscope with an endoscope camera as the additional feature. It is concluded that the time of intubation using an endoscope camera modified laryngoscope has no significant difference from that of standard laryngoscope, but in terms of convenience there is a significant difference.

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