International Journal of Research in Medical Sciences
Yazıcı MM et al. Int J Res Med Sci. 2023 May;11(5):1509-1513
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20231312

Original Research Article

Comparison of traditional and online education in airway management

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Received: 11 March 2023
Revised: 12 April 2023
Accepted: 12 April 2023

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ABSTRACT

Background: Endotracheal intubation is commonly used to maintain the airway during airway management, but it requires skill and experience, so standard endotracheal intubation performed by beginner managers carries a high risk of failure. This study was conducted based on the hypothesis that there are differences between the traditional and online education models in terms of learning and skill development in situations requiring basic skills, and it aimed to compare the traditional and online education models to evaluate endotracheal intubation learning and skills.
Methods: This single-centre, prospective study aimed to evaluate the endotracheal intubation performance of volunteers. The research involved examining the endotracheal intubation experience of fourth-year medical school students who completed their education either traditionally or online at the Recep Tayyip Erdogan university simulation-based learning centre (RSIM). Approval was obtained before commencement from the local ethical committee (decision no. 2023/03, E-40465587-050.01.04-572).
Results: Mean time for successful intubation in the traditional and online education models evaluated was statistically significant at the non-difficult (p=0.005), moderately difficult (p=0.007) and difficult airway (p=0.014) levels.
Conclusions: Traditional and online education models affect endotracheal intubation ability. In endotracheal intubation with either a direct or a video laryngoscope, the traditional education model offered a more successful experience than the online education model. In addition, skills with the video laryngoscope were stronger in novice users than with the direct laryngoscope.

Keywords: Endotracheal intubation, Airway management, Medical education

INTRODUCTION

Endotracheal intubation is commonly used to maintain the airway during airway management, but it requires skills and experience, so standard endotracheal intubation performed by beginner managers carries a high risk of failure.[1,2] In addition, the unknown medical and traumatic conditions of patients who require intubation in emergencies sometimes render airway management difficult with a direct laryngoscope.[3,4] However, the evolution of video laryngoscopy has reduced difficulty of airway management during endotracheal intubation.[5,6]

Medical education involves a dynamic process that considers changing knowledge and basic skill requirements. Therefore, according to today's needs, medical education includes active learning models, such as integrated, interactive, and dynamic applications (problem-based learning) and e-learning (online).[7,8] During the COVID-19 pandemic, the revision of the 'online' education model was part of keeping up with the changing dynamic situation.

This study was conducted based on hypothesis that there are differences between traditional and online education

models in terms of learning and skill development in situations requiring basic skills, and it aimed to compare traditional and online education models to evaluate endotracheal intubation learning and skill development.

METHODS

Study design

This single-centre, prospective study aimed to evaluate the endotracheal intubation performance of volunteers. The research included examining the endotracheal intubation experience of fourth-year medical school students who completed their education either traditionally or online at the Recep Tayyip Erdogan university simulation-based learning centre (RSIM). This study was performed between January and February 2023. Approval was obtained before commencement from the local ethical committee (decision no. 2023/03, E-40465587-050.01.04-572).

All volunteer fourth-year medical students who did not meet the exclusion criteria were enrolled in the study. The exclusion criteria were applied in two steps: first, volunteers who received endotracheal intubation education previously or had endotracheal intubation experience were excluded. At the second step, volunteers who did not complete traditional or online education or who did not attend simulation evaluation were excluded.

Study protocol

Volunteer fourth-year medical students were registered in Microsoft excel in order of application, and those meeting the first exclusion criterion (four volunteers) were removed during the initial step, after which two groups were formed. The first group was the 'traditional education' group and the second the 'online education' group. The groups were created using the 'index' and 'randbetween' formulas in Microsoft excel. Both groups were subjected to an education session of equal duration (30 min). While the traditional education group received endotracheal intubation education on slides and models in person, the online education group received endotracheal intubation education on slides via the Zoom® platform. Volunteers who completed the education were subjected to endotracheal intubation experience three weeks later, and those who met the final exclusion criterion (two volunteers) were removed at this step. The studies flowchart is shown in Figure 1.

Three degrees of difficulty were set for the airway. The first was the 'non-difficult airway', with two digits of height and an ordinary tongue; the second was the 'moderately difficult airway', with two digits of height and a swollen tongue; and the third was the 'difficult airway', with five digits of height and a swollen tongue. Figure 2 shows the airway difficulty levels at which airway management evaluated with direct laryngoscope (Macintosh) and a video laryngoscope (C-MAC®).

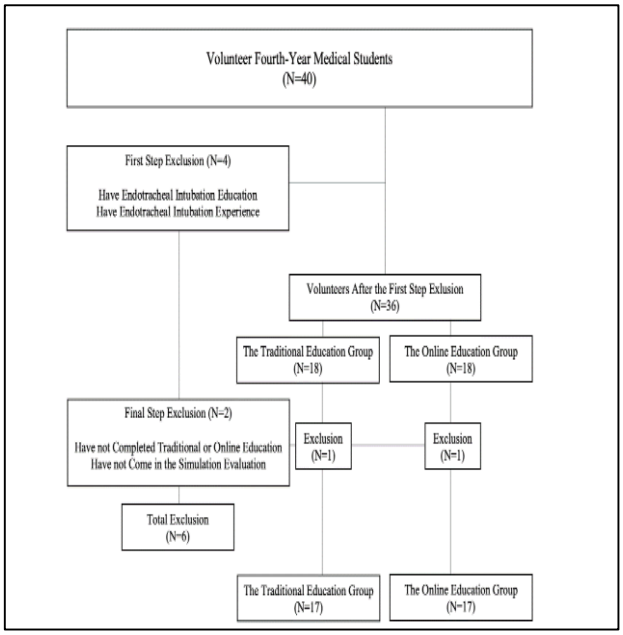

Figure 1: Study flowchart.

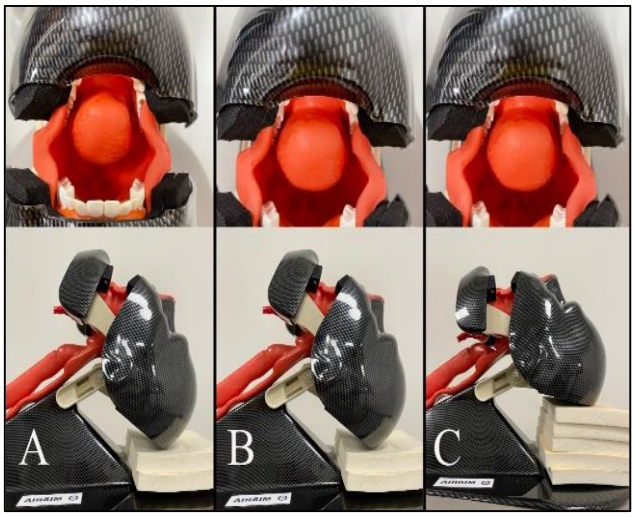

Figure 2 (A-C): Airway difficulty levels. Non-difficult airway, moderately difficult airway, difficult airway.

The time required for successful intubation by each volunteer was recorded during the assessment, where the duration of successful intubation was defined as the time that elapsed between the moment the volunteer received the laryngoscope in their hand and the moment both lungs were equally ventilated. In addition, the number of failed intubations, right-left tracheal intubations, dental manipulations and oesophageal intubations were recorded.

Endpoints

The primary endpoint of this study was the evaluation of whether traditional or online education models differ in terms of learning and skill development for endotracheal intubation. The secondary endpoint was the evaluation of

direct and video laryngoscope experiences of volunteers with no previous endotracheal intubation experience.

Statistical analysis

All analyses were performed using the Jamovi v.1.6 statistical software (The Jamovi Project [2021] computer software, version 1.6, Sydney, Australia). Categorical data were expressed in frequency (n) and percentage, and normally distributed continuous variable data were described as the mean plus standard deviation (SD) and non-normally distributed data as the median and interquartile range (IQR). The normality of distribution was evaluated using the Shapiro–Wilk test, while the t-test/paired t-test was applied to compare continuous variables in the case of a normal distribution and the Mann-Whitney U/Wilcoxon test in the case of a non-normal distribution. Finally, the chi-square test was used to compare categorical variables between the groups.

RESULTS

Forty volunteers applied for the study. After employing the inclusion as well as exclusion criteria, 34 volunteers, including 20 (58.8%) men and 14 (41.2%) women, were included in the study. The median age of the patients was 23 (IQR 23-24) years. The demographic data of the volunteers' are summarized in Table 1.

Airway management was evaluated with a direct and a video laryngoscope at different difficulty levels. The mean time for successful intubation in the assessment of a 'non-difficult airway,' 'moderately difficult airway,' and 'difficult airway' with direct laryngoscopy the meantime for successful intubation according to the traditional and online education models evaluated was statistically significant (non-difficult airway p=0.005) (moderately difficult airway p=0.007) and (difficult airway p=0.014). The mean time for successful intubation in the assessment of a 'non-difficult airway,' 'moderately difficult airway,' and 'difficult airway' with video laryngoscopy the meantime for successful intubation according to the traditional as well as the online education models evaluated was statistically significant (non-difficult airway p=0.001) (moderately difficult airway p=0.002) and (difficult airway p=0.008). The statistics of volunteers' endotracheal intubation skills according to education are summarised in the Table 2.

Finally, the mean times for successful intubation according to the volunteers' direct laryngoscope and video laryngoscope skills are shown in the Table 3.

Table 1: The volunteers' demographic data.

Variables	All volunteers', (n=34)	Traditional education volunteers', (n=17)	Online education volunteers', (n=17)
Gender, n (%)			
Male	20 (58.8)	10 (29.4)	10 (29.4)
Female	14 (41.2)	7 (20.6)	7 (20.6)
Age (Year)	23 (IQR 23-24)	23 (IQR 23-24)	23 (IQR 23-24)

IQR: Interquartile range. Note: Normally distributed data are expressed as mean ± SD (Min.-Max.), abnormally distributed data as median (IQR 25-75). Note 2: Categorical data were expressed in frequency (n) and percentage.

Table 2: Volunteers' endotracheal intubation skills according to education.

Variables	Direct laryngoscope endotracheal intubation		P	Video laryngoscope endotracheal intubation		P
Non-difficult airway	**TEV**	**OEV**		**TEV**	**OEV**	
ETT (seconds)	14.4±3.2 (11.1-22.8)	18.5±4.6 (12.3-25.2)	0.005	12.2±1.8 (9.8-15.6)	16±3.8 (9.4-22.5)	0.001
FEI	0	2	0.485	2	1	1.000
RTEI	0	0	-	0	0	-
LTEI	0	1	1.000	0	0	-
EEI	0	1	1.000	1	1	1.000
DM	2	4	0.656	0	1	1.000
Moderate-difficult airway	**TEV**	**OEV**		**TEV**	**OEV**	
ETT (seconds)	15.9±3.0 (11-21.8)	19.7±4.7 (12.9-27.8)	0.007	14.2±2.3 (10.7-18.9)	18.1±4.3 (11.3-26.5)	0.002
FEI	3	0	0.227	0	0	-
RTEI	1	0	1.000	0	0	-
LTEI	0	0	-	0	0	-
EEI	2	0	0.485	0	0	-
DM	1	6	0.085	1	4	0.335

Continued.

Variables	Direct laryngoscope endotracheal intubation		P	Video laryngoscope endotracheal intubation		P
Difficult Airway	**TEV**	**OEV**		**TEV**	**OEV**	
ETT (seconds)	22.2±4.9 (14.1-30.3)	27.2±6.2 (18.3-38.4)	0.014	19.1±4.0 (12.3-28.2)	23.4 ± 5.0 (16.7-32.6)	0.008
FEI	1	0	1.000	3	6	0.688
RTEI	0	0	-	1	1	1.000
LTEI	0	0	-	1	0	1.000
EEI	1	0	1.000	1	4	0.335
DM	7	8	0.730	5	7	0.473

ETT: Endotracheal intubation time (seconds), FEI: Failed endotracheal intubation, RTEI: Right tracheal endotracheal intubation, LTEI: Left tracheal endotracheal intubation, EEI: Esophageal endotracheal intubation, DM: Dental manipulation, TEV: Traditional education volunteers', OEV: Online education volunteers. Note: Normally distributed data are expressed as Mean ± SD (Min.-Max), Abnormally distributed data as median (IQR 25-75).

Table 3: Volunteers' direct laryngoscope and video laryngoscope skills, (n=34).

Variables	All volunteers		P
Non-difficult airway	**DLEI**	**VLEI**	
ETT (seconds)	16.5±4.4 (11.1-25.2)	14.1±3.5 (9.4-22.5)	0.001
Moderate-difficult airway	**DLEI**	**VLEI**	
ETT (seconds)	17.8±4.4 (11-27.8)	16.2±4.0 (10.7-26.5)	0.002
Difficult airway	**DLEI**	**VLEI**	
ETT (seconds)	24.7±6.1 (14.1-38.4)	21.2±5.0 (12.3-32.6)	0.001

ETT: Endotracheal intubation time (seconds), DLEI: Direct laryngoscope endotracheal intubation, VLEI: Video laryngoscope endotracheal intubation. Note: Normally distributed data are expressed as mean ± SD (Min.-Max), Abnormally distributed data as median (IQR 25-75).

DISCUSSION

Endotracheal intubation is generally employed to maintain the airway during airway management, but it requires skill and experience, and the unknown medical and traumatic conditions of patients who require intubation in emergencies sometimes complicate airway management via direct laryngoscopy.[3,4] Thus, the evolution of video laryngoscope has reduced the difficulty of airway management during endotracheal intubation.[5,6]

Ti et al hypothesised that experiential learning might facilitate the learning and retention of endotracheal intubation skills. Fourth-year medical students assessed their intubation skills after receiving guided or experiential training; as a result, novices learned and retained the skills of endotracheal intubation better following experiential learning.[9] Further, Andresen et al. investigated the tracheal intubation competencies among medical students, concluding that the use of simulated scenarios could be a helpful tool for tracheal intubation learning.[10] In our study, the effect of traditional and online education models on endotracheal intubation skill development was evaluated. In intubation with direct and video laryngoscopy, the traditional education model offered a more successful experience than the online education model with non-difficult, moderately difficult, and difficult airways. However, among education models, there is a similar degree of consideration of failed endotracheal intubation, right tracheal intubation, left tracheal intubation, oesophageal intubation, and dental manipulation. As a result, we observed that the experiential education model is more useful for learning basic skills, such as endotracheal intubation, a result similar to that of many studies in the literature.[11,12]

Pujari et al used a video laryngoscope and direct laryngoscope to compare endotracheal intubation experiences, and they found the video laryngoscope more effective when endotracheal intubation is performed by novice airway medical students than the direct laryngoscope.[13] In the systematic review of Lewis et al they examined experiences with a direct laryngoscope and video laryngoscope among adult patients requiring tracheal intubation, and they found the video laryngoscope could reduce the number of failed intubations, especially in patients with a difficult airway.[14] Our study evaluated the effect of a direct laryngoscope and a video laryngoscope on endotracheal intubation skills, where the video laryngoscope provided a more successful experience when intubating non-difficult, moderately difficult and difficult airways compared to the direct laryngoscope, and these findings were similar to those in the literature.

In Tarasi et al the endotracheal intubation skills of medical students were evaluated, wherein it was inferred that clinical experience could offer an appropriate strategy for medical students to improve their procedural skills.[15] In the systematic review of Buis et al learning assessments of endotracheal intubation using a direct laryngoscopy were examined, and they determined that to

ensure an excellent endotracheal intubation experience, one must have conducted more than 50 endotracheal intubations.[16] Our study evaluated the first experience with volunteers with no previous endotracheal experience; we think that more experience will result in more successful intubation.

Limitations

There are some limitations of this study. The first is that the nature of the single-centre investigation limits the generalisation of our results. Second, due to the study design, it included an evaluated simulation, not reality.

CONCLUSION

Traditional and online education models affect endotracheal intubation ability. In endotracheal intubation with a direct and a video laryngoscope, the traditional education model offered a more successful experience than the online education model. In addition, skills with a video laryngoscope are stronger in novice users than with the direct laryngoscope.

ACKNOWLEDGEMENTS

Author would like to thank the department of emergency medicine for their hard work on their help in data collection.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Yazıcı MM, Ataş I, Güler E, Bilir O. Comparison of traditional and online education in airway management. Int J Res Med Sci 2023;11:1509-13.