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EVALUATION OF SKILL ACQUISITION OF VIDEOLARYNGOSCOPY IN COMPARISON TO DIRECT LARYNGOSCOPY IN POSTGRADUATE MEDICAL STUDENTS: A MANIKIN STUDY

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ABSTRACT

Background: Direct laryngoscopy with Macintosh laryngoscope (ML) is the gold standard technique for tracheal intubation. However, visualization of the larynx and subsequent tracheal intubation may not be possible in difficult airways. TruView video laryngoscope (TVL) can provide good visualization of the glottis and visual confirmation of tracheal intubation in a difficult airway scenario. This manikin study was carried out to compare the skill acquisition for videolaryngoscopy using TVL and compare it with direct laryngoscopy using ML, in easy and difficult airway scenarios, in TVL novice participants.

Material and methods: Thirty resident doctors were randomized to participate in a crossover, manikin study. Participants were asked to intubate a manikin in easy and difficult airway scenarios using TruView and Macintosh laryngoscope. Two trials were conducted at one-week interval and at the end of each trial parameters of Intubation time, Cormack-Lehane (CL) grading, success of intubation and ease of intubation which reflect skill acquisition were recorded. All 30 participants completed the study.

Results: In the easy scenario most results were comparable between the two devices. The TVL scored over ML in all aspects of difficult intubation with significantly lesser time for intubation (23.27 ± 1.8sec, P<0.0001), lower CL grade (1&2-100%), higher success of intubation in the first attempt (83.33%, P=0.0016) and greater ease of intubation (100%, P<0.0001).

Conclusion: TVL scores over ML in difficult airway scenarios in novice users of TVL, within a short learning time.

KEYWORDS :

INTRODUCTION

Establishing and securing the airway, especially in emergency patients, is one of the primary responsibilities of an anesthesiologist. Airway related complications contribute to large percentage of hypoxic brain damage (60%) and death (72%).[1] Macintosh laryngoscope (ML) is commonly used for tracheal intubation. However anatomical factors may preclude visualization of the larynx with this device. Despite numerous tests, prediction of all difficult airways is impossible, and unanticipated difficult intubations are encountered in the operating rooms, critical care, and emergency department units. [2,3] Recently developed Video laryngoscope (VL) finds a place in the ASA difficult airway algorithm,[4] but its use is highly technical and operator dependent. TruView (TVL) is a robust, optical device which offers better laryngeal visualization with a 42-degree deflection prism, viewed through a 15 mm eyepiece which can be connected to a video screen.[5] It is portable ensuring that it can be used in out of operating room settings. Training resident doctors with advanced devices using simulators, aids in the development of skill, competency and expertise required for airway management in emergency situations. In this study we compared intubation outcomes between TVL and standard ML, when intubated by trainees, novice with TVL. The primary aim of this study was to compare time required for intubation between TVL and ML in a manikin model. Secondary outcomes compared were CL grading [7], success of intubation and ease of intubation [8].

MATERIAL AND METHODS

The study was approved by the Institutional Ethics Committee. Thirty resident doctors specializing in anesthesiology or medicine were recruited and randomized to perform intubation with TVL or ML in a crossover design. Participants with >50 intubations experience in using a ML and no experience with TVL were included in the study. Written informed consent was obtained from the participants. Resident doctors with more than three years of experience in performing intubation with ML and with previous experience with VL were excluded from the study.

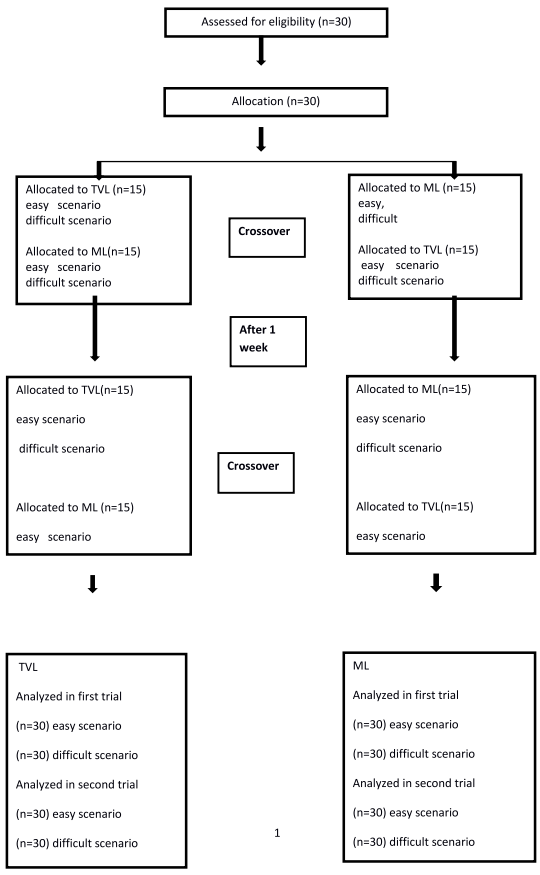

Figure 1: Consort Flow Diagram

All participants were asked to practice intubation once on the manikin with a Macintosh laryngoscope (Greenlight II TM, GE Healthcare, USA) to familiarize them with the anatomy of adult manikin. A video demonstration on the instructions to use TruView EVO2TM video laryngoscope (Truphatek, Netanya, Israel) was conducted. Participants performed intubation on the Laerdal® Airway Management Trainer (Laerdal Medical, Stavanger, Norway). An easy airway scenario and a difficult airway scenario [11] created by manual in-line stabilization (MILS) for intubation in unstable cervical spine injury was used on the manikin.

In case of TVL, the larynx was visualized through the eyepiece without attachment of a camera. A hockey stick, J shaped stylet with endotracheal tube number 6.5 was used for intubation. Intubation was attempted by all the participants in both the scenarios using TVL and ML in a crossover fashion. The allocation sequence was determined using sealed opaque envelopes. Thus, they were randomly assigned to use the instrument into two groups with fifteen participants in each group. Each participant attempted the easy scenario first, followed by the difficult scenario, for the laryngoscope assigned to them. Then they used the other instrument keeping the sequence of scenarios the same. Two trials (I & II) were conducted one week apart, and at the end of each trial, intubation time, CL grading [7] (Appendix 1), success of intubation and ease of intubation [8] (Appendix 2) were recorded. The time of intubation was recorded from the time of picking up the laryngoscope until confirmation of ventilation with the AMBU bag. A maximum of two attempts of intubation were allow ed. If intubation time was >120 seconds, it was considered as a failed attempt. All 30 participants completed the study

Figure 1
Figure1(a): Intubation with TVL in easy scenario
Figure1(b): Intubation with TVL in difficult scenario

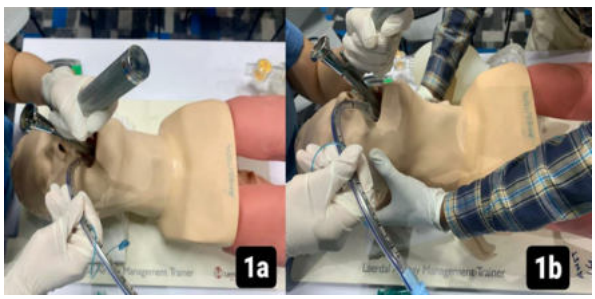

Figure 2

Figure2(a): Intubation with McIntosh in easy scenario
Figure2(b): Intubation with McIntosh in difficult scenario

Statistical Analysis:
Sample size was calculated using a priori power analysis to detect a difference in power of 0.8, at an α- level set at 0.05. Based on a pilot study, in which we found a difference in mean intubation time of 10 seconds between the two devices with a standard deviation of 12 seconds, a group size of 24 was calculated. To account for dropouts, 30 participants were included in the study. Data was analyzed using statistical software R version 4.0.3. Categorical variables were presented as percentage, whereas continuous variables were presented as Mean±Standard Deviation. Chi-square test and Fisher's test was applied to evaluated the association between attributes. Two-sample t test was applied to compare means. P <0.05 was considered statistically significant.

RESULTS:
A total of 30 resident doctors completed the study. There were 12 male and 18 female participants. The mean age of participants was 25.66±1.18 years.

Each participant performed at least one intubation with each device in two scenarios in each trial. In addition, second attempt at intubation was required by 10 participants in the easy scenario. 37 participants required a second attempt in the difficult scenario.

As seen in Table 1, in the easy scenario, intubation with ML was faster. Intubation time was lesser with TVL in the difficult scenario when compared to ML

Table 1: Intubation time with TVL and ML

Trials	Time taken for intubation (seconds)		P-value	
	TruView video laryngoscope (TVL)	Macintosh laryngoscope (ML)		95% Confidence interval (CI)
	Easy scenario			
I	22.87 ± 2.36	21 ± 1.86	0.0012*	0.7718 to 2.9682
II	21.9 ± 1.97	19.67 ± 1.52	< 0.0001*	1.3206 to 3.1394
	Difficult scenario			
I	24.27 ± 2.08	35.2 ± 3.43	< 0.0001*	-12.396 to -9.464
II	23.27 ± 1.87	37.1 ± 2.06	< 0.0001*	-14.84 to-12.81

* Indicates statistical significance

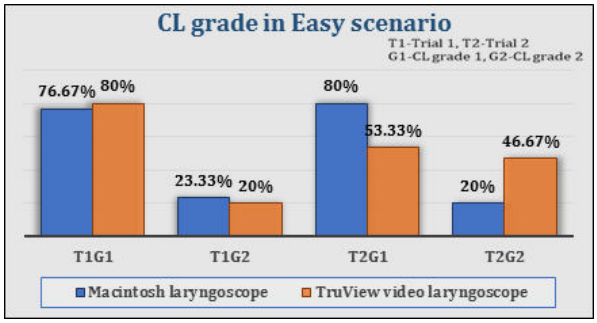

Figure 3(a) Distribution of CL grade in easy scenario.

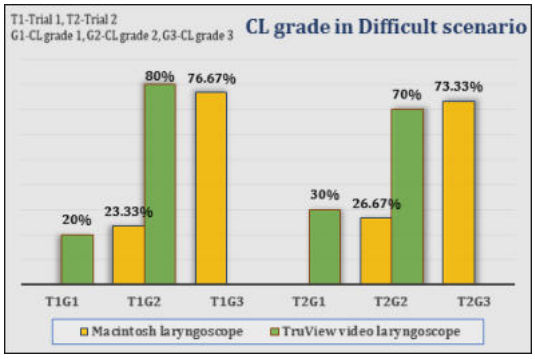

Figure 3(b): Distribution of CL grade in the difficult scenario

CL grading in the two trials showed higher grade and difficulty in visualizing larynx (grade 3 in 76.67%, 73.33) in the difficult scenario with use of ML.

Table 2: Rate of successful intubation in the easy and difficult scenarios

Trial I & II	TVL(n=60)		ML(n=60)		P-value
Success of intubation	First attempt	Second attempt	First attempt	Second attempt	
Easy scenario	53 (88.33%)	7 (11.66%)	57(95%)	3(5%)	0.3218
Difficult scenario	50 (83.33%)	10 (16.66%)	33(55%)	27(45%)	0.0016*

* Indicates statistical significance (Fisher's Test)

Success of intubation in first attempt was comparable with both laryngoscopes in the easy scenario, but was significantly higher with TVL in the difficult scenario (P=0.0016)

Table 3: Ease of intubation.

Trial I & II	TVL(n=60)		ML(n=60)		P-value
Ease of intubation scale	Easy (1&2)	Moderate (3)	Easy (1&2)	Moderate (3)	
Easy scenario	60(100%)	0(0%)	60 (100%)	0(0%)	1.0000
Difficult scenario	60(100%)	0(0%)	19 (31.66%)	41 (68.33%)	<0.0001*

* Indicates statistical significance (Fisher's Test)

In the easy scenario, participants found both the instruments comparable and easy to use. In difficult scenario, TVL was reported to be an easy instrument to use when compared to ML

DISCUSSION

Airway management in routine and emergency practice is an essential skill required to prevent airway related morbidity and mortality. VL score better over direct laryngoscopes in easy laryngeal visualization and intubation, even in difficult airway situations.[9] It is important for trainee resident doctors to undergo low risk, intensive training to operate advanced airway equipment confidently in routine and emergency situations. In this study, though the participants were familiar with the use of ML, they were novices with TVL. TVL is an optical indirect laryngoscope, unlike other VLs, which use video images and fiberoptics. The techniques of intubation with TVL and DL are quite different. With the TVL held in the left hand a view of the larynx is achieved through the eye piece, the right hand steers the ET in the direction of the glottis, requiring acquisition of psychomotor skills well applied in laparoscopic surgery training [10]. This proficiency to obtain an image of the laryngeal inlet followed by successful maneuvering of endotracheal tube into the glottis can be achieved through simulated training sessions. In our study, we assessed that, though the mean time required for intubation in the easy scenario with TVL was higher, in the difficult scenario it was significantly less (23.27 ± 1.87s vs 37.1 ± 2.06s). Researchers [5] concluded that an experienced user would need lesser time to intubate with this VL.

VL enhances laryngeal view in subjects with normal and difficult airways.[5] We used manual inline stabilization to create a difficult airway scenario, mimicking clinical conditions, since the technique is used for cervical spine immobilization preferentially over the rigid cervical collar during laryngoscopy in trauma victims.[11,12] .Here, the assistant stands by the side of the patient and holds the head of the patient with both hands to prevent movement of the cervical spine, due to the force applied during laryngoscopy[12]. Mihai et al [13], in a meta-analysis, noted improved CL grades in 67.7% patients and a worsening in 4.2% patients with use of VL. He did not include mannequin studies. In our study, in both trials of the difficult scenario, CL grade was significantly better with TVL (Grade 2- 80%,70%). ML showed CL grade 3 (76.67%,73.33%) which was not seen with TVL at all.[7] Use of TVL lead to improved grades of CL. Gu Y et al [14] observed that intubation was faster with VL even when there was a restricted laryngeal view (27s vs 36s) in restricted and full glottic views respectively.

Success of intubation at first attempt in our study was comparable between TVL and ML in the easy scenario, but was significantly higher with TVL in the difficult scenario (83.33%) when compared to ML (55%). This may partly be due to the improved laryngeal views seen with TVL. Lewis et al [15] in a Cochrane systematic review, reported that use of a VL particularly with reference to a difficult scenario, a decreased rate of intubation failure when the procedure was performed by doctors experienced with both VL and ML.

Indirect laryngoscopes were preferred by participants for ease of intubation compared to ML in a study by Lye et al [8]. Analysis of perception of users to TVL, using ease of intubation scale in our study, reflected that, users found TVL a better device in difficult scenario(P<0.0001).

We studied all the factors such as intubation time, CL grading, success of intubation and ease of intubation which are likely to contribute to achieving successful intubation in a real-world clinical setting. The present study reports statistically favorable clinical endpoints in a difficult airway with VL.[15]

Simulation, a valuable teaching aid, allows a procedure to be repetitively performed over a short time period to enhance technical and cognitive skills of the trainee. [16] Most studies have been conducted on mannequins in a single trial. However, we have studied all the parameters in two trials to test reproducibility of results. Bradbury et al [17] studied the C-MAC VL and Salvodelli et al. [18] studied the ability of the operator to acquire the skill within a few intubations. Yi et al studied the McGrath, Pentax and Macintosh laryngoscope in novice nurses and reported higher first attempt success rate, easier intubation and better glottis view in cervical immobilized mannequin model with VLs. [19]

Many authors recommend training in airway management with indirect laryngoscopes in addition to ML. [8] to minimize the risk of airway related complications [1]. If this training program is started in residency, the benefit to the patients during clinical duties will be seen. Improved clinical performance after simulation training in airway management has been documented in a few studies. [20]

Limitations:

Manikins may not reliably mimic clinical airway conditions due to the use of rigid plastics and absence of collapsible tissues. Factors such as obesity cannot be mimicked on a mannequin. Further studies to translate success on mannequins to success in clinical settings are required.

Appendix 1: Cormack Lehane (CL) Grade of Laryngeal View [7]

Grade 1	Visualization of entire glottic aperture
Grade 2	Visualization of only posterior aspect of glottic aperture
Grade 3	Visualization of epiglottis
Grade 4	Visualization of only soft palate

Appendix 2: Ease of Intubation Scale [8]:

Very easy	1
Easy	2
Moderate	3
Difficult	4
Impossible	5

CONCLUSIONS

This study demonstrated superiority of TVL in difficult airway scenarios over ML. Use of TVL in routine airways is comparable with ML. Use of VL in the training program for resident doctors to achieve competency in airway management is beneficial.

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