

Endotracheal intubation with Optical Stylet Vs Macintosh Laryngoscope performed on a manikin by medical students: A prospective manikin trial

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Abstract

Objective: To investigate laryngoscopic images, intubation time, intubation success, satisfaction and ease of use of a Macintosh laryngoscope and the Clarus optical stylet among inexperienced medical students.

Methods: The prospective, experimental study was conducted at Pamukkale University, Denizli, Turkey, from May to June 2017, and comprised medical school term VI students who had never before carried out endotracheal intubation. A standardised oral presentation and demonstration of the intubation technique with each device were given. Elements measured were success rate of orotracheal intubation, successful intubation time, number of intubation interventions, Cormack-Lehane classification, usefulness and satisfaction with the devices. SPSS 21 was used for data analysis.

Results: Of the 94 subjects, 60(63.8%) were females. The overall mean age was 24.38±0.94 years. Compared to the direct laryngoscope, the optical stylet recorded a better success rate at first attempt ($p<0.001$), as well as with intubation time ($p<0.001$), pleasure ($p<0.001$) and usefulness ($p<0.001$).

Conclusion: The use of an optical stylet increased endotracheal intubation success among inexperienced users.

Keywords: Optical stylet, Direct laryngoscope, Airway management, Intubation time, Medical school students. (JPMA 69: 1651; 2019). doi: 10.5455/JPMA.6843.

Introduction

¹The purpose of advanced cardiac life support (ACLS) is to maintain respiration and circulation, and the most important factor in breathing is the airway. Moreover, patients who are unable to protect the airway against aspiration, maintain airway patency, ventilate, oxygenate and anticipate a deteriorating prognosis eventually leading to respiratory failure are highly likely to be exposed to intubation. The insertion of a tube into the trachea to secure the airway or to control respiration is known as endotracheal intubation (ETI), and the most commonly used intubation method is direct laryngoscopy. Being cost-effective, reliable and easy-to-access, Macintosh laryngoscopes have for many years been the most popular devices for direct orotracheal intubation in adult patients, although their use requires a certain level of experience. The ETI success rates of inexperienced individuals have been recorded at 35-65% with a direct laryngoscope, and

it has been shown that at least 50 direct laryngoscopes should be carried out if this ratio is to be increased to 90%.¹ This has led to an increase in the number of alternative methods, aiming at reducing difficulties and at achieving successful intubation. The 2010 American Heart Association (AHA) guide recommends ETI for those experienced during resuscitation as a Class 1 practice, although the presence of anatomical disorders in the airways of some patients and the presence of systemic diseases (e.g. ankylosing spondylitis, goitre, etc.) may make intubation difficult.^{2,3}

Unexpected intubation difficulties are a major problem in emergency departments (EDs), with incidences of difficult laryngoscopies reportedly ranging 1.5-20%.^{4,5} Difficult laryngoscopies may result from the lack of a good glottic imaging, which is graded 1-4 in the classification of Cormack-Lehane (CL).⁶ Optical intubation stylets are rigid, straight-lined devices with an angular stiffness characteristic at certain grades, and are useful in the intubation of patients with problematic airways.^{7,8}

The current study was planned to investigate

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laryngoscopic images, intubation time, intubation success, satisfaction and ease of use of direct laryngoscopes and optical stylets among inexperienced medical students.

Subjects and Methods

The prospective, experimental study was conducted at Pamukkale University, Denizli, Turkey, from May to June 2017, and comprised medical school term VI students who had never before carried out ETI. Approval was obtained from the institutional ethics committee.

After getting consent from the subjects, they were given a standardised oral presentation and demonstration of intubation techniques with each of the two devices. The CL table was shown and explained while the laryngoscopic image was being described.⁶ Vocal cords were seen totally in grade 1, partly in grade 2, only a hole behind epiglottis in grade 3, and epiglottis alone in grade 4, according to the CL classification⁶. Subsequently, each participant made at least two successful intubations with both devices. The practitioners were taken in one by one, and weren't allowed to interact during breaks. All intubation procedures were performed using a No. 7.0 endotracheal tube (ETT), and a direct laryngoscope with a number 3 Macintosh blade and Clarus (Tel Aviv / Israel) optical stylet were used (Figure 1). Provided next to the model in which the head and neck were in the normal position was a set of direct laryngoscope and optical stylet, a No. 7.0 ETT with lubricant gel, a cuff injector and a rigid stiffener for use only with the Macintosh laryngoscope. The head tilt chin lift manoeuvre by the practitioner was allowed during the procedure.⁹ External airway manipulation, such as the backward, upward, and right-sided pressure manoeuvres, or the modified jaw thrust manoeuvre by an assistant, was not permitted.¹⁰ The success rate of orotracheal

intubation of each student, as well as successful intubation time, number of intubation interventions, CL classification, usefulness and satisfaction with devices were measured. For intubation, a time frame within 60 seconds was considered a success, while failure to achieve intubation within 60 seconds, or the misplacement of the oesophagus intubation and / or tubing was considered unsuccessful, and the next trial was attempted.¹¹ If the practitioners failed in three experiments, the intubation process was terminated and considered unsuccessful.

The primary endpoint of the trial was the time required for successful tracheal intubation. The duration of tracheal intubation was calculated as the time from when the laryngoscope was placed in the mouth until the endotracheal tube was inflated. After each intubation procedure, a laryngoscopy image was shown to each subject and was asked whether it resembled the CL classifications. The responses were recorded. Finally, the participant was asked to rate their satisfaction with the usability of each device on a scale of 0 to 10 on a numerical rating scale (NRS).

For sample size calculation, G*Power Version 3.1.9.2 (HeinrichHeine-Universität, Dusseldorf, Germany) software was used.¹² Given that the difference between two dependent means (matched pairs) would have a small effect size ($d_z=0.3$) a sample size calculation was performed before the study, keeping 0.05 alpha (α) level error probability and 90% power ($1-\beta$) level error probability. For pleasure results, we reached 100% power with 95% confidence ($d_z=1.33$) and for usefulness results, we reached 100% power with 95% confidence ($d_z=1.55$). SPSS 21 was used for data analysis. Continuous variables were reported as mean \pm standard deviation (SD) and median with interquartile range (IQR). Categorical variables were reported as frequencies and percentages. Kolmogorov-Smirnov test was used for testing normality. Wilcoxon Signed Rank test was used for comparing dependent groups. McNemar test was used to detect possible differences in ETI success rate. $P<0.05$ was considered statistically significant.

Results

Of the 119 students approached, 94(79%) had never conducted ETI and were thus enrolled. Of them, 60(63.8%) were female. The overall mean age was 24.38 ± 0.94 years. Of the total, 92(97.8%) ETIs performed with the optical stylet were successful in the first attempt, and 2(2.2%) in



Figure-1: Macintosh laryngoscope (A) and Clarus optical stylet (B).

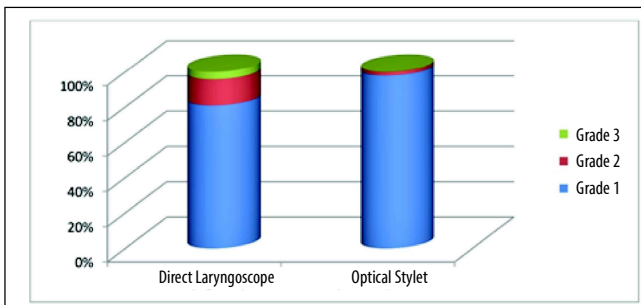


Figure-2: Direct laryngoscope and optical stylet attempts.

the second. In direct laryngoscopic intubations, 76(80.9%) succeeded in the first attempt, while 18(19.1%) were successful in more than one attempts (Figure 2). A significant difference was noted between the two methods ($p < 0.001$) (Table 1).

All intubations performed with the optical stylet were rated CL grade I. For direct laryngoscope, the grades were: 54(57.4%) grade I, 35(37%) grade II, 4(4.3%) grade III and 1(1.1%) grade IV (Figure 3) (Table 2).

The median time of intubation performed with direct

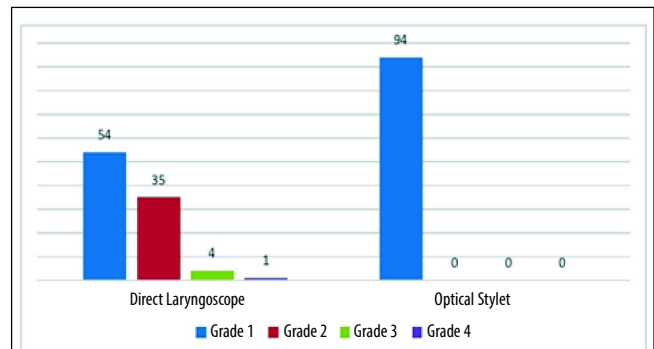


Figure-3: Direct laryngoscope and optical stylet Cormack-Lehane (CL) grades.

laryngoscope was 15.22 sec (IQR: 11.69-20.72) compared to 8.85 sec (IQR: 6.83-12.30) with optical stylet ($p < 0.001$). The median value of satisfaction in the direct laryngoscope method was 7 (IQR: 5-8), and the calculated median usefulness value was 6 (IQR: 4-8). The corresponding values for optical stylet were 9.5 (IQR: 8-10) and 9.5 (IQR: 9-10) ($p < 0.001$) (Table 3).

Discussion

The current study recorded a first-attempt successful intubation rate of 97.8% in inexperienced users when using an optical stylet, while a direct laryngoscope also achieved a high success rate of 80.9%. Approximately 19% of the participants needed a second and third attempt with the direct laryngoscope. In most studies carried out to date assessing the success of intubations with the two methods, the participants were experienced with the direct laryngoscope method, but inexperienced with the optical stylet.¹³⁻¹⁵ In contrast, the present study included inexperienced participants who were trained for the first time in both the direct laryngoscope and optical stylet methods.

Similar to a study involving paediatric manikins and 89 paramedics, 97.8% of the intubations performed with the optical stylet and 88.9% of the direct laryngoscope intubations were successfully achieved at the first attempt.¹³ The Clarus Video System (CVS) was successful in the first attempt in 51 (85%) of 60 patients in intubation procedures performed by

Table-1: Number of intubation attempts with direct laryngoscope and optical stylet.

Direct Laryngoscope Number of Attempt	Optical Stylet Number of Attempt			*p-value
	One Attempt	More than One Attempt	Total	
One Attempt	75 (%79.8)	1 (%1.1)	76 (%80.9)	<0.001
More than One Attempt	17(%18.0)	1 (%1.1)	18(%19.1)	
Total	92 (%97.8)	2 (%2.2)	94 (%100)	

*p-value derived from a McNemar test.

Table-2: Cormack-Lehane (CL) grades of direct laryngoscope and optical stylet.

Cormack-Lehane Grade	Direct Laryngoscope n (%)	Optical Stylet n (%)
Grade 1	54(57.4)	94(100)
Grade 2	35(37.2)	0(0)
Grade 3	4(4.3)	0(0)
Grade 4	1(1.1)	0(0)
Total	94(100)	94(100)

Table-3: Direct laryngoscope and optical stylet NRS values and intubation times.

	Direct Laryngoscope		Optical Stylet		p-value
	Mean ± SD	IQR	Mean ± SD	IQR	
Intubation Time (s)	16.41 ± 6.46	15.22 (11.69 - 20.72)	9.97 ± 4.47	8.85 (6.83 - 12.3)	0.0001* (z=-7.576)
Pleasure NRS	6.56 ± 1.98	7 (5 - 8)	8.91 ± 1.42	9.5 (8 - 10)	0.0001* (z=-6.981)
Usefulness NRS	6.13 ± 2.02	6 (4 - 8)	8.96 ± 1.53	9.5 (9 - 10)	0.0001* (z=-7.034)

*p-values derived from a Wilcoxon Signed Rank Test, Data reported as Mean ± Std.Dev and Median (IQR), SD: Standard deviation, IQR: Interquartile range, NRS: Numerical Rating Scale

two practitioners with no experience with the device, while seven were successful at the second attempt and two were successful at the third attempt.¹⁴ In a study, anaesthesiologists compared the flexible fibre-optical (FO) bronchoscope and video stylet methods, and found that 8 of the 30 patients in the video stylet group needed a second intubation attempt.¹⁵ In a study of 60 patients, in which a rigid cervical collar was applied, a video laryngoscope and optical stylet were used in each group, and the initial success rate of the optical stylet (30 patients) was recorded at 93%.¹⁶ A study compared the OptiScopeTM (a rigid video stylet) with a conventional light-wand intubation in 168 cervical spine-immobilised patients, applied by three experienced anaesthetists, and a 90% success rate using the OptiScopeTM was achieved in the initial attempt.¹⁷ A study recorded a 96.3% first attempt success rate using an optical stylet in a study involving 81 emergency medical technicians and manikins.¹⁸ In a study, the success rate at the initial intubation was higher with the OptiScopew (89.9%) method than with the Macintosh method (80.4%).¹⁹ In a study, all 30 participants made a successful first-attempt intubation with an optical stylet (Bonfils Intubation Fiberscope).⁷ In another study involving emergency physicians (EPs) in a simulated difficult airway scenario, the direct laryngoscope intubation scored a 65% success rate on the first attempt, while 20% required three or more attempts. In contrast, the CVS method recorded a 100% success rate with a single attempt.²⁰ Whether it is a normal airway scenario or a difficult airway scenario, all these studies reveal that the success of intubations carried out with optical stylet always produces higher first-attempt success, which shows that intubations through optical stylet facilitate the control of airway safety. As in the aforementioned studies, the rate of successful intubation in the first attempt was established to be high in our study, too. In other words, the participants performed intubation with optical stylet more successfully than with direct laryngoscope.

According to the CL classification in our study, all intubations performed with the optical stylet were scored as grade I; while with the direct laryngoscope method, 57.4% were evaluated as grade I and 37.2% were grade II. In one study, all intubations performed using an optical stylet were scored as grade I, while the grades for direct laryngoscope were grade I (78.7%) and grade II (21.3%).¹³ In a study with 25 anaesthetists, the percentage of glottic

opening (POGO) scale score for InnoScope was 100% and for the Macintosh laryngoscope the POGO scale was 80%.²¹ One study recorded CL grades I / II / III / IV with a Macintosh laryngoscope (n: 199) of 89 / 92 / 16 / 2, and with an OptiScope (n: 198) of 87 / 96 / 14 / 1, respectively.¹⁹ A study recorded CL grade I (23/30) and grade 2 (7/30) in intubations performed with an optical stylet (Bonfils Intubation Fiberscope).⁷ In the studies conducted through optical stylet, a highly clear laryngoscopic view was achieved, and grade 1 scoring was obtained in CL classifications. On the other hand, in studies with difficult airway scenario, though CL grades suffer to some extent, they yield better results in optical stylet groups than in direct laryngoscope groups. In the pertaining studies with normal scenario, the CL grade 1 group in intubation with optical stylet proved to be at higher rates, similar to our study. Though these rates decreased to some extent in the studies on difficult airway scenario, they are still higher in the optical stylet group than its direct laryngoscope.

In our study, the median time of intubation performed with a direct laryngoscope was 15 seconds compared to the median time of intubation performed with an optical stylet of 8.85 seconds. A study reported the median time for intubation of 18 seconds for direct laryngoscope and 17 seconds for optical stylet.¹³ Another study recorded intubation times of 20 seconds for InnoScope and 18 seconds for Macintosh laryngoscope.²⁰ Another study recorded an intubation time of 24.6 seconds with optical stylet, while one study recorded an intubation time of 19.7 seconds with a video stylet.^{14,15} Another study achieved an intubation time of 19 seconds with a rigid video stylet (OptiScopeTM).¹⁷ In a study, the successful application period of the optical stylet was 14.50 seconds.¹⁸ Intubation times with an OptiScopew (15 seconds) were shorter than with Macintosh method (18 seconds).¹⁹ In a study, the time of intubation was 14 seconds, and in another, the average time for an independent direct laryngoscope intubation in a simulated difficult airway scenario was 43.41 seconds, compared to 38.71 seconds with CVS.^{7,21} Though the length of time strings out a little in difficult airway scenarios, the pertaining studies demonstrate that the duration of intubation tend to be shorter in optical stylet groups than their direct laryngoscope counterparts. The intubation duration with optical stylet turned out to be shorter in our study than the other studies. In the studies on difficult airway scenarios, the intubation duration was longer. Better CL

grades in optical stylet groups contribute to higher first-attempt success and naturally to shorter intubation duration.

In our study, the direct laryngoscope satisfaction value was 7 and the usefulness value was 6, based on NRS scores given by the participants, compared to nearly 9.5 for the optical stylet in both factors. In one study, ease of intubation in the optical stylet group was found to be very easy by 87.6% participants, while 55.1% of the direct laryngoscope group found the method to be very easy.¹³ A study claimed that it was subjectively easier to intubate a simulated difficult airway using the Shikani optical stylet, with 90% of intubations graded easy.¹⁶ In one study, the participants reported a relatively high level of satisfaction with the CVS, with the survey results indicating a median satisfaction rate with CVS of 9, and a usefulness rate of 9.18 In another study, EPs rated ≥ 6 in terms of satisfaction and usefulness, and more than half of them rated the method at 9-10.²¹ Similar to the other studies, the satisfaction and usefulness values were higher in the optic stylet group in our study. The better outcomes of the first-attempt success, intubation time, and laryngoscopic view according to the CL classification all highlight the satisfaction and usefulness of optical stylet over direct laryngoscope.

Although positive results were obtained in practice by the current study, the findings need to be supported by studies evaluating the use of devices on actual patients rather than manikin, and in a clinical setting, allowing the method to be assessed in the presence of complications.

Conclusions

Intubations by inexperienced practitioners with an optical stylet provided a better laryngoscopic view of the manikin than a direct laryngoscope, and the use of optical stylets increased the level of ETI success among inexperienced users. Intubations performed using optical stylet were also faster and easier among the inexperienced users.

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