Jacek Smereka[1], Marek Dabrowski[2], Mateusz Puslecki[3], Mateusz Szarek[4], Damian Gorczyca[4],
Zuzanna Popielarska[4], Dominika Dunder[4], Jerzy Robert Ladny[5], Karol Bielski[4], Szymon Bialka[6],
Kurt Ruetzler[7], *Lukasz Szarpak[4]

Should we use a guide during endotracheal intubation in normal and difficult airways? A randomized, cross-over, simulation study. Pilot data

Czy powinniśmy stosować prowadnicę podczas intubacji dotchawiczej w warunkach normalnych i trudnych drogach oddechowych? Randomizowane krzyżowe badanie symulacyjne – badania pilotażowe

[1]Department of Emergency Medical Service, Wroclaw Medical University, Poland
[2]Chair and Department of Medical Education, Poznan University of Medical Sciences, Poland
[3]Department of Rescue Medicine, Poznan University of Medical Sciences, Poland
[4]Lazarski University, Warsaw, Poland
[5]Department of Emergency Medicine, Medical University of Bialystok, Poland
[6]Department of Anaesthesiology and Intensive Care, Medical University of Silesia, Katowice, Poland
[7]Departments of Outcomes Research and General Anesthesiology, Anesthesiology Institute, Cleveland Clinic,
 Cleveland, Ohio, USA

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Address/adres:

*Lukasz Szarpak
Lazarski University
43 Swieradowska Str., 02-662 Warsaw,
Poland
Phone: +48 500186225
E-mail: lukasz.szarpak@gmail.com

S u m m a r y

Introduction. Protecting airway patency in emergency medicine situations is one of the basic activities performed in relation to a person in a state of immediate life threat. Despite the introduction of supraglottic ventilation devices for use, endotracheal intubation is still the gold standard for respiratory protection.

Aim. The aim of the study is to evaluate the effectiveness of endotracheal intubation performed with and without an intubation guide carried out by students in their final year of medical studies.

Material and methods. In a study designed as a randomized trial, 47 students in their final year of medical studies took part. Participants in the study performed endotracheal intubation on an adult using a standard laryngoscope with a Macintosh blade in two techniques: with and without an intubation guide. Intubation was carried out in two scenarios: Scenario A – normal airways; Scenario B – difficult airways. We analyzed the effectiveness of intubation, the duration of the procedure, the degree of visualization of the glottis or the ease of performing the procedure.

The study protocol was approved by the Program Board of the Polish Society for Disaster Medicine (Approval No. 34.02.2018.IRB).

Results. The median time to intubation with and without stylet was compared for each of the aforementioned scenarios. For scenario A, time to first ventilation was achieved fastest for tube with stylet, 24.9 s (IQR: 21-32.5), when compared to that of tube without stylet at 29.5 s (IQR: 24-35) (p = 0.013). In scenario B, the time for intubation with and without stylet varied and amounted to 43.5 s (IQR: 29.5-52) vs. 52 s (IQR: 43-57.5) (p = 0.001). During Scenario A, the effectiveness of the first intubation trial using stylet compared to intubation without stylet was 44.7 vs. 27.6%, while the total efficiency was 100% in both cases. In the case of scenario B, the effectiveness of the first attempt to intubate with and without stylet was 27.6 vs. 17%, and total intubation efficiency 78.7 vs. 42.6%.

Conclusions. Endotracheal intubation using an intubation guide was associated with a higher efficacy of the first intubation trial, a shorter duration of the procedure, as well as a lower degree of difficulty in the procedure.

Streszczenie

Wstęp. Zabezpieczenie drożności dróg oddechowych w warunkach medycyny ratunkowej stanowi jedną z podstawowych czynności wykonywanych względem osoby w stanie bezpośredniego zagrożenia życia. Pomimo wprowadzenia do użytku nadgłośniowych urządzeń do wentylacji, intubacja dotchawicza stanowi nadal złoty standard zabezpieczenia dróg oddechowych.

Cel pracy. Celem pracy jest ocena efektywności intubacji dotchawiczej z prowadnicą intubacyjną i bez prowadnicy intubacyjnej wykonywanej przez studentów ostatniego roku studiów medycznych.

Materiał i metody. W badaniu zaprojektowanym jako badanie randomizowane, krzyżowe udział wzięło 47 studentów ostatniego roku studiów medycznych. Uczestnicy wykonywali intubację dotchawiczą osoby dorosłej za pomocą standardowego laryngoskopu z łopatką Macintosha w dwóch technikach: z prowadnicą intubacyjną i bez prowadnicy intubacyjnej. Intubacja odbywała się w dwóch scenariuszach badawczych: scenariusz A – normalne drogi oddechowe, scenariusz B – trudne drogi oddechowe. Analizie poddano skuteczność intubacji, czas trwania procedury, stopień uwidocznienia głośni czy też łatwość wykonania procedury.

Protokół badania został zaakceptowany przez Radę Programową Polskiego Towarzystwa Medycyny Katastrof (protokół: 30.02.2018.IRB).

Wyniki. Mediana czasu intubacji z prowadnicą intubacyjną i bez prowadnicy dla poszczególnych scenariuszy badawczych była zróżnicowana. Dla scenariusza A czas do pierwszej próby wentylacji był krótszy przy zastosowaniu prowadnicy – 24,9 s (IQR: 21-32,5), w porównaniu z intubacją bez prowadnicy – 29,5 s (IQR: 24-35) (p = 0,013). W scenariuszu B czas intubacji ze sztyletem i bez sztyletu wynosił odpowiednio 43,5 s (IQR: 29,5-52) vs. 52 s (IQR: 43-57,5) (p = 0,001). Podczas scenariusza A skuteczność pierwszej próby intubacji z wykorzystaniem sztyletu w porównaniu z intubacją bez sztyletu wynosiła 44,7 vs. 27,6%, zaś całkowita skuteczność wynosiła w obu przypadkach 100%. W przypadku scenariusza B skuteczność pierwszej próby intubacji ze sztyletem i bez sztyletu wynosiła 27,6 vs. 17%, zaś całkowita skuteczność intubacji 78,7 vs. 42,6%.

Wnioski. Intubacja dotchawicza z wykorzystaniem prowadnicy intubacyjnej wiązała się wyższą skutecznością pierwszej próby intubacji, krótszym czasem trwania procedury, jak również niższym stopniem trudności wykonania procedury.

INTRODUCTION

The protection of upper airway patency plays a fundamental role in resuscitation procedures regardless of the cause of sudden cardiac arrest. It is one of the basic skills that should be demonstrated by medical personnel working in the healthcare system (1, 2).

Endotracheal intubation is still one of the medical activities that pose quite a challenge even for the most experienced people in this skill, which classifies it in the forefront of procedures performed in emergency medicine with the highest risk of iatrogenic diseases (3). At the same time, it is also one of the most effective methods of instrumental airway protection because it provides the possibility of asynchronous ventilation in relation to compression, prevents regurgitation, and provides the possibility of positive end-expiratory pressure (PEEP) ventilation in respiratory therapy (4, 5). The decision to intubate a patient consists of many factors, i.e. the patient's respiratory capacity, hypoventilation and hypercapnia as well as the number of points in GCS (Glasgow Coma Scale). Due to the diversity of individual conditions and numerous indirect factors (lighting, patient position, body structure, etc.) affecting the correct positioning of the endotracheal tube in direct laryngoscopy, instruments supporting this medical procedure were developed (6-10).

AIM

The aim of the study is to evaluate the effectiveness of endotracheal intubation performed with and without an intubation guide performed by final year medical students under normal and difficult airways conditions.

MATERIAL AND METHODS

The research is a continuation of research carried out by authors whose aim is to search for the most effective method of intubation (9, 11-14). The study was designed as a randomized, cross-over study and was performed based on medical simulation. The study protocol was approved by the Program Board of the Polish Society for Disaster Medicine (Approval No. 34.02.2018.IRB). The study involved 47 final year medical students participating in Advanced Cardiovascular Life Support training (ACLS) conducted by accredited American Heart Association instructors. Written voluntary informed consent was taken from each participant.

Scenario simulation

Prior to the study, all participants successfully completed ACLS training. Next, the instructor demonstrated the correctness of intubation using the Macintosh laryngoscope. Subsequently, the participants had a 10-minute training session during which

they performed endotracheal intubation using a Macintosh laryngoscope and a standard endotracheal tube without a guide using AT Kelly Torso (Laerdal, Stavanger, Norway).

During the target study, a SimMan 3G adult simulator (Laerdal, Stavanger, Norway) was used to simulate a patient in need of endotracheal intubation, which was placed on the floor in a brightly lit room. The study participants performed endotracheal intubation with and without intubation stylet (fig. 1). Endotracheal intubation was performed based on two research scenarios:

- Scenario A – normal airway,
- Scenario B – difficult airway. Difficult airways were obtained by inflation of the tongue using software that controlled the simulator, so as to obtain the visibility of the glottis at level 3 by Cormack-Lehane scale (15).

Both the order of the participants and the research methods were random. For this purpose, the ResearchRadomizer program was used. A detailed procedure for randomization of the study is presented on figure 2.
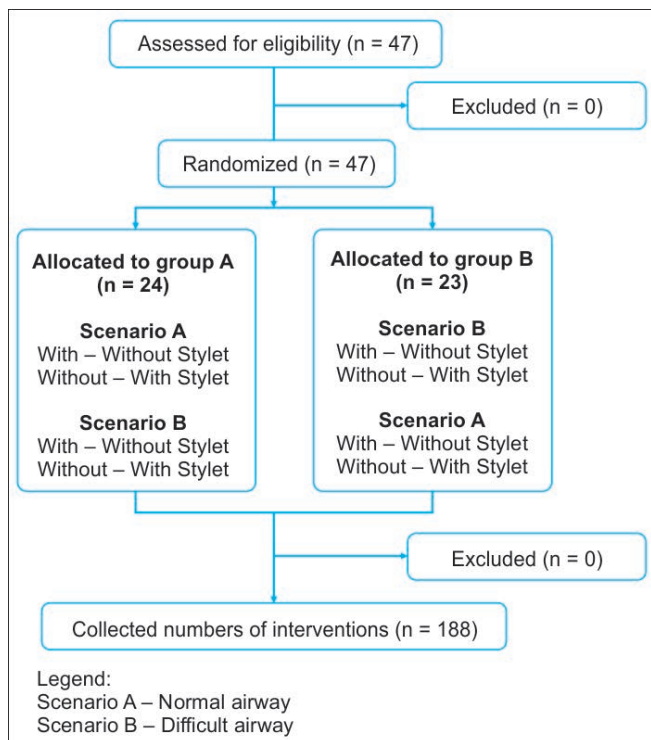

Fig. 1. Endotracheal tube with semirigid stylet

Legend:
Scenario A – Normal airway
Scenario B – Difficult airway

Fig. 2. Randomization flow chart

Measurements

The basic parameter measured in the study was the assessment of the effectiveness of the first intubation attempt, assessed by the correctness of chest elevation in the case of ventilation with the use of endotracheal tube and self-expanding bag, additional confirmation was obtained thanks to the readings of the parameters indicated by the software controlling the simulator. In addition, the total intubation efficacy assessed against a maximum of three intubation tests performed by study participants was measured. The next parameter measured in the study was intubation time, defined as the time from hand-in-hand by performing laryngoscope intubation until an effective ventilation test using a self-expanding bag. In addition, both the percentage of glottic opening and the ease of intubation was assessed. The percentage of glottic opening (POGO) score was defined as the glottic visual highlighting rate based on direct laryngoscopy. Ease of technical use was defined as a scale from 1 to 100, where "1" – meant an easy procedure, and "100" – as a very difficult procedure to perform.

Statistical analysis

All statistical analyses were performed with the statistical package Statistica v.12EN (StatSoft, Tulusa, OK, USA). Normal distribution was assessed using the Kolmogorov-Smirnov test. Categorical data are reported as frequency (n) and percent (%) and numerical data as median and interquartile range (IQR). Fisher's exact test was used to compare categorical data. Numerical data was analyzed using the Mann-Whitney U-test and/or the Kruskal-Wallis test. Statistical significance was set as a two-tailed p-value of less than 0.05.

RESULTS

Fourty seven final year medical students participated in the study. Before joining, all persons participating in the study it successfully completed the training module in the field of emergency medicine.

Scenario A – Normal airway

The effectiveness of the first attempt to intubate with and without intubation stylet was varied and amounted to 44.7% vs. the acquired data 27.6% (p = 0.016) (tab. 1). The overall effectiveness in both cases was 100%. Intubation time with intubation stylet was 24.9 s (IQR: 21-32.5) and was statistically significantly shorter than in the case of intubation without a guide – 29.5 s (IQR: 24-35, p = 0.013) (fig. 3). There was no significant difference in the POGO score between the intubation methods. The ease of performing the intubation procedure measured with the use of a 100-degree scale, showed statistically significant differences between the methods of intubation: 34 points (IQR: 28-39) for intubation with stylet,

and 51 points (IQR: 36-54) for intubation without stylet (p = 0.007) (fig. 4). 57.4% of participants in the study would re-intubate with the guide as the preferred method for endotracheal intubation.

Tab. 1. Results of Scenario A – Normal airway

Parameter	Without stylet	With stylet	p-Value
Number of attempts 1 2 3	13 (27.6%) 17 (29.8%) 20 (42.6%)	21 (44.7%) 16 (34.0%) 10 (21.3%)	0.016
Overall intubation success rate	47 (100%)	47 (100%)	NS
Intubation time (s)	29.5 (IQR: 24-35)	24.9 (IQR: 21-32.5)	0.013
POGO Score (%)	32 (IQR: 21-35)	31 (IQR: 23-37)	NS
Ease of technical use (1-100)	51 (IQR: 36-54)	34 (IQR: 28-39)	0.007
Willingness of reuse (1-100)	20 (42.6%)	27 (57.4%)	< 0.001

NS – not statistically significant
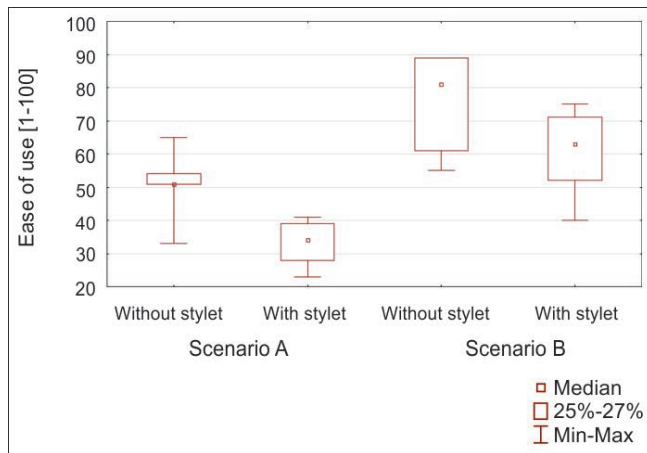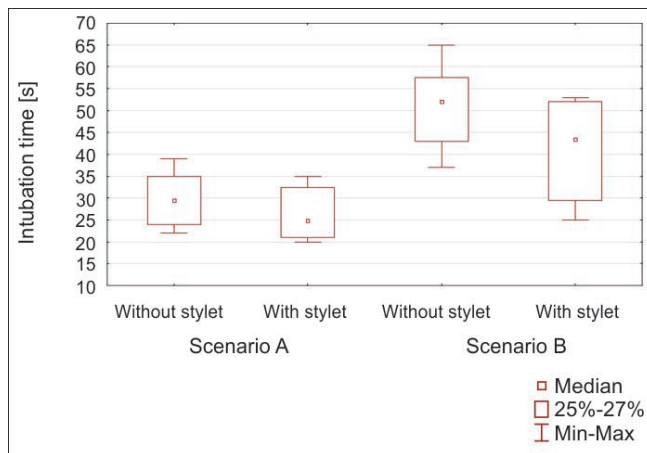

Fig. 3. Median intubation time

Fig. 4. Ease of intubation

Scenario B – Difficult airway

Data are shown in detail in table 2. During scenario B, intubation using a guide compared to intubation without a guide was associated with a higher efficacy of the first intubation attempt (27.6 vs. 17.0%), and overall efficacy (78.7 vs. 42.6%, p < 0.001). In the case of intubation using the median guide, the intubation time was 43.5 s (IQR: 29.5-52), and was statistically significantly shorter than in the case of intubation without the 52 s guide (IQR: 43-57.5, p = 0.001) (fig. 3). The ease of intubation using a guide was associated with a more easy procedure than intubation without a guide (p = 0.025) (fig. 4).

Tab. 2. Results of Scenario B – Difficult airway

Parameter	Without stylet	With stylet	p-Value
Number of attempts 1 2 3	8 (17.0%) 7 (14.9%) 5 (10.6%)	13 (27.6%) 16 (34.0%) 8 (17.0%)	0.011
Overall intubation success rate	20 (42.6%)	37 (78.7%)	< 0.001
Intubation time (s)	52 (IQR: 43-57.5)	43.5 (IQR: 29.5-52)	0.001
POGO Score (%)	72 (IQR: 66-80.5)	72 (IQR: 65-81)	NS
Ease of technical use (1-100)	81 (IQR: 61-89)	63 (IQR: 52-71)	0.025
Willingness of reuse (1-100)	2 (4.3%)	45 (95.7%)	< 0.001

NS – not statistically significant

DISCUSSION

The conducted study showed that intubation using the guide is a more effective method of intubation performed by last year medical students in both normal and difficult airways.

Intubation of the tracheal tube using the guide was associated with a higher efficiency of the first intubation test in both normal and difficult airways. Also Tosh et al. indicate that when using the Bougie guide during intubation with the C-MAC laryngoscope, intubation was easier and faster than using the tracheal tube without a guide (16). In the case of tests carried out by Driver et al. (17) the use of Bougie's guide was also associated with a higher efficiency of the first intubation attempt. Lee et al. Also reached similar conclusions (18).

In addition, Komasawa et al. indicated that, stylet use increases the incidence of postoperative pharyngeal pain (19). In broadcasting Biro et al., the authors used a hybrid steerable semi-rigid S-shaped video stylet. Intubation using a guide in the case of normal airways has been shown to be more effective than intubation with an endotracheal tube without a guide, moreover intubation stylet has a great potential for anaesthetized and paralyzed patients (20).

The study used a Macintosh laryngoscope, due to the fact that it is one of the most available types of laryngoscopes. However, endotracheal intubation requires adequate experience. The learning curve for direct laryngoscopy is about 50 attempts of intubation (21-23).

However, students of their final year of medical studies take training modules in the field of anesthesiology and emergency medicine, during which they learn to perform respiratory protection based on endotracheal intubation. As indicated by numerous studies, endotracheal intubation performed on the basis of direct laryngoscopy is associated with high efficacy in normal airway conditions, however this effectiveness may be reduced in the case of difficult airway (24-27). This trend was also observed in this study. However, the effectiveness of intubation may also be reduced in other clinical situations, such as continuous chest compressions during cardiopulmonary resuscitation (12, 28), or immobilization of the cervical spine for trauma patients (29, 30).

The study has limitations. One of the main limitations is performing a test based on medical simulation, not during real emergency operations, however, the use of the patient's simulator during testing allows for full standardization of the conditions of performing medical procedures, as well as allows randomized, cross-controlled trials without health impairment to a potential patient (9, 12). The second limitation is to conduct the study only on the basis of the research group consisting of final year medical students, however, such a selection of the research group was the fact that last year medical students should demonstrate the ability to protect the airway obstruction in the case of airway obstruction or circulation arrest. The strength of the study is its randomized, cross-shaped nature.

CONCLUSIONS

In the performed simulation test, endotracheal intubation with the use of an intubation guide was associated with a higher efficiency of the first intubation trial, a shorter duration of the procedure, as well as a lower degree of difficulty in the procedure.

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