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CAN THE FACE-TO-FACE INTUBATION TECHNIQUE BE USED DURING CARDIOPULMONARY RESUSCITATION? A PROSPECTIVE, RANDOMIZED, CROSSOVER MANIKIN TRIAL

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ABSTRACT

BACKGROUND: Endotracheal intubation in cardiopulmonary resuscitation conditions is the gold standard for the protection of airway patency, allowing for both ventilation with positive pressures and continuous monitoring of carbon dioxide concentration in the exhaled air, as well as enabling continuous chest compressions.

AIM: The aim of the study was to compare the effectiveness of endotracheal intubation performed with the usage of Macintosh laryngoscope in two positions: behind the patient's head and in the face-to-face position.

METHODS: We included 54 students during their final year of medicine in the study. All of participants declared the ability to perform endotracheal intubation based on direct laryngoscopy. Prior to the study, all participants took part in the training in laryngoscopy and cardiopulmonary resuscitation. During the study, the participants performed intubation in the simulated resuscitation environment in two scenarios: Scenario A — intubation from behind the patient;s head, Scenario B — face-to-face intubation. Participants had a maximum of three intubation attempts. The chest compressions were paused during the procedure.

RESULTS: The effectiveness of the first intubation attempt in the case of scenario A was 44.4%, while in the case of scenario B — 24.1%. The overall success ratios of intubation for scenarios A and B were 88.9% vs. 53.7%, respectively. The median intubation time during scenario A was 43.5 [IQR; 34–53.5] seconds, and 54.5 [IQR; 38.5–59.5] seconds for scenario B.

CONCLUSIONS: In the study, intubation performed by final-year medical students while taking a position behind the head of the victim was of a higher efficiency when compared to the face-to-face position.

KEY WORDS: endotracheal intubation, direct laryngoscopy, cardiopulmonary resuscitation, efficacy

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INTRODUCTION

Despite the advances the medicine has made over recent decades, sudden cardiac arrest [SCA] still remains a huge medical and social problem. It is the main cause of death in both Europe and North America [1, 2]. In Europe, SCA affects from 16 to 119 people per 100,000 inhabitants per year depending on the definition, while on a global scale SCA occurs in 95.9/100,000 inhabitants annually [3]. Gacha et al. [4], conducted 12-month observations

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in the Polish population among adults living in the Bielsko region which showed that the combined number of SCA incidents was 170/100,000 per year and was higher among males than females (243/100,000 and 99/100,000, respectively). Other authors' studies also confirm more frequent SCA among males [5–7]. Müller et al. [8], in his study, found the average age of patients with out-of-hospital cardiac arrest (OHCA) to be 68 ± 14 years for men, and 76 ± 12 years for women. SCA occurs most often in people in the 7–8th decade of life [8, 9]. The management of patient in cardiac arrest requires medical personnel to perform high quality chest compressions and appropriate ventilation. The current American Heart Association Cardiopulmonary Rescue guidelines recommend endotracheal intubation to be performed with maintained chest compressions, or with a minimal break, to allow the intubation tube to be inserted securely between the vocal folds. This approach minimizes breaks in between chest compressions and therefore improves organ perfusion. However, numerous studies show that the effectiveness of endotracheal intubation during cardiopulmonary resuscitation (especially with maintained chest compressions) is insufficient [10–12]. Therefore, it is important to look for new endotracheal intubation techniques that will increase the effectiveness of the procedure. The aim of the study was to assess the efficacy of endotracheal intubation performed during cardiopulmonary resuscitation simulation.

MATERIAL AND METHODS

The study was designed as a prospective, randomized cross-over study. The study protocol had been previously accepted by the Institutional Review Board of the International Institute of Rescue Research and Education (Approval no. 103.2017.IRB). A total of 54 medical students during their last year of studies were included. Participation in the study was voluntary. Prior to the study, all participants had received two-week training in the field of emergency medicine, during which an Advanced Cardiovascular Life Support and Airway Management course was conducted in accordance with the American Heart Association guidelines. During the course, all participants practiced endotracheal intubation with the use of a Macintosh laryngoscope and they had to perform 50 endotracheal intubation attempts. After completing the training session, the participants were asked to perform endotracheal intubation in a simulated cardiopulmonary resuscitation. A Manusin Resusci Anne QCPR Manikin (Laerdal, Stavanger, Norway) was used to simulate the patient during resuscitation. All of the participants used a Macintosh laryngoscope with blade no. 3 (Heine USA Ltd. Dover, NH). Intubation was performed in two scenarios: Scenario A — the person performing intubation was behind the head of the victim; Scenario B — a person performing intubation performed it with the face-to-face method [13]. Both the order of the participants and the research scenarios were randomized by ResearchRandomizer program. A detailed randomization procedure is presented in Figure 1.

Time to intubation (TTI), defined as the time from picking up the airway device until the first successful ventilation of the lungs, served as our primary outcome. Additional secondary outcomes were as follows: a subjective evaluation of ease of use using a visual analogue scale (VAS) score ranging from 1 (extremely easy) to 10 (extremely difficult); and the overall success rate of intubation. Vocal cord visualization was assessed with Cormack & Lehane classification [14] which was performed after each intubation attempt. Finally, participants were asked which device they would prefer in a real-life emergency intubation setting.

A statistical analysis was performed using the Statistica Software version 13.3 for Windows (Tibco, Tulsa, OK, USA). Data is presented as number (percentage), mean ± standard deviation (SD), or median [interquartile range (IQR)], as appropriate. Nonparametric tests were used for the data that did not have a normal distribution. All statistical tests were 2-sided. The Wilcoxon test for paired observations was used to compare the different times and to determine the statistical difference for each group. The McNemar test was used to evaluate the differences in intubation success rates. The Cormack-Lehane grade, ease of intubation score, severity of dental injury score and preferred airway device were evaluated using the Stuart-Maxwell test. A p value < 0.05 was considered statistically significant.

RESULTS

A total of 54 medical students during their final year of studies were included. All participants had successfully completed training in emergency medicine

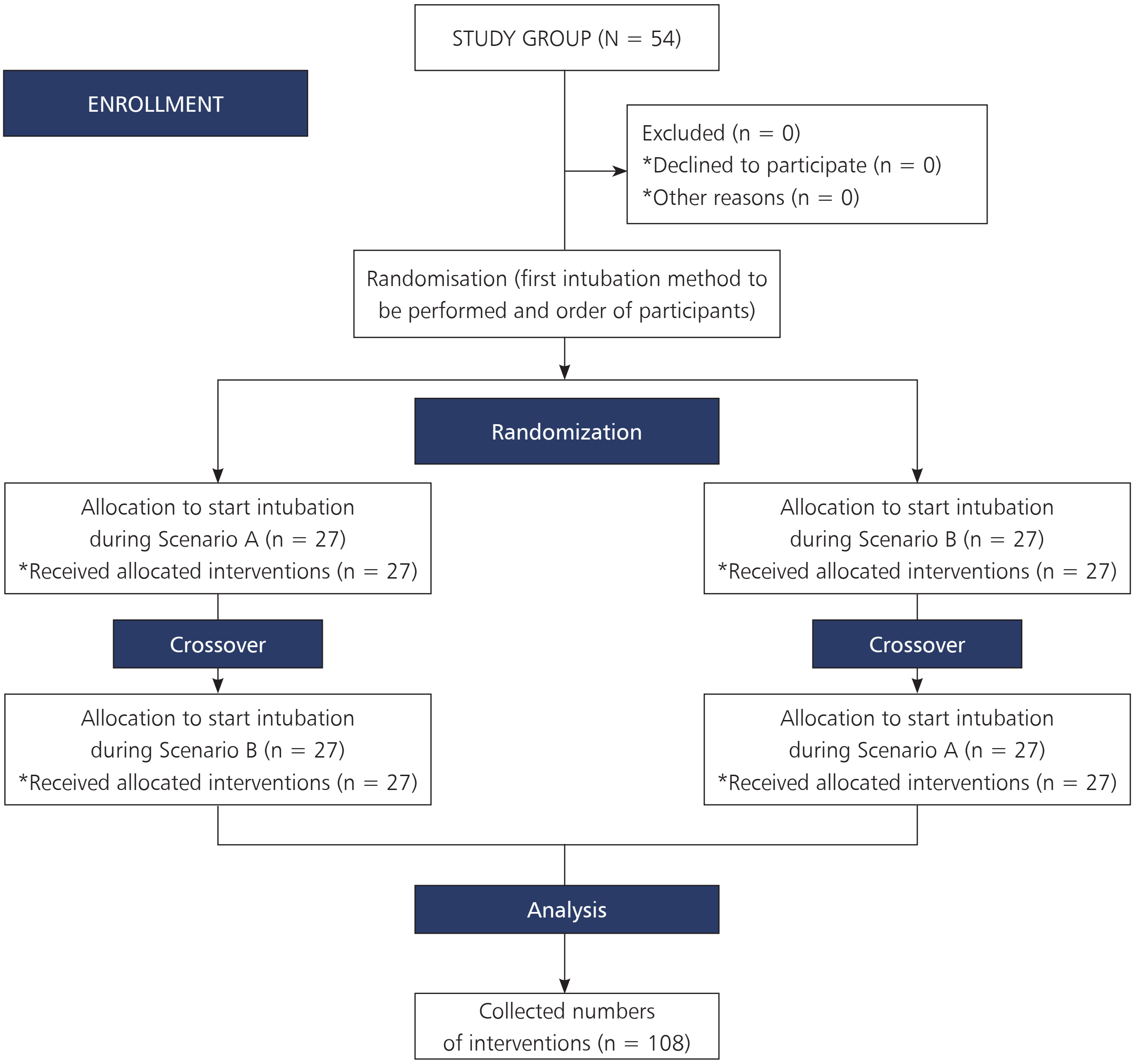

FIGURE 1. Study flow chart

and declared their ability to perform endotracheal intubation using direct laryngoscopy.

Success rate

The efficacy of the first intubation attempt during scenario A and B varied and was 44.4% and 24.1%, respectively ($p < 0.001$) with the overall efficacy of intubation in scenario A was 88.9% and 53.7% for scenario B. There was a statistically significant difference in the overall success of scenarios A and B ($p < 0.001$).

Time to successful intubation

The median time to successful endotracheal intubation during scenario A and scenario B is presented in Figure 2. The statistical analysis showed a significantly shorter time of intubation during scenario A — 43.5 [IQR: 34–53.5] seconds, compared to scenario B — 54.5 [IQR; 38.5–59.5] seconds. The difference in intubation time was statistically significant ($p < 0.001$).

Rating of the distinct ETI scenarios

There was no statistically significant difference between Scenario A and Scenario B in the Cormack-Lehane scoring system (Tab. 1). However, a difference in the ease of endotracheal intubation was statistically significant based on the VAS score. Scenario A was evaluated by participants at 4.5 [IQR: 3–5.5] points and scenario B was rated as much more difficult at 6.7 [IQR: 4.5–7] points ($p = 0.035$).

Table 1. Cormack-Lehane classification data during scenario A and scenario B

Cormack-Lehane grade	Scenario A	Scenario B	P-value
I	12 (22.2%)	11 (20.4%)	0.035
II	35 (64.8%)	17 (31.5%)	
III	4 (7.4%)	21 (38.9%)	
IV	3 (5.6%)	5 (9.2%)	

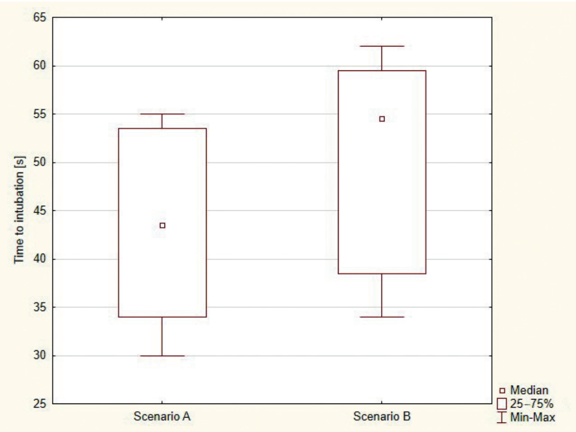

FIGURE 2. Median time to intubation using distinct methods

DISCUSSION

Endotracheal intubation during cardiopulmonary resuscitation is one of the core methods of protection of airway patency [15–17]. In the conducted study, face-to-face intubation compared to behind-the-head intubation during the first intubation attempt was associated with lower efficacy and prolonged duration. The time is of the essence when performing an endotracheal intubation during cardiopulmonary resuscitation. In the study conducted on the paramedic test group [18], the effectiveness rate of the face-to-face method at the first intubation attempt was 88.7% and at the median time of 33.5 (IQR, 26–40.5) seconds. Higher success rates and shorter times of intubation by paramedics may be caused by the fact that in Polish conditions paramedics learn to perform endotracheal intubation during their studies. Arslan et al. [19] presented data that the usage of video laryngoscopy may increase success rates of face-to-face endotracheal intubation. In his study, 3rd year medical students performed intubation utilizing the GlideScope and AirTraq with success rate of 100% and 67%, respectively. Amathieu et al. [20] undertook a prospective randomized comparison of the LMA Fastrach, Airtraq laryngoscope, and GlideScope which were used for face-to-face tracheal intubation simulation to mimic an entrapped patient. In this study of face-to-face tracheal intubation, the highest success rate was achieved with Airtraq (100%), when compared with that of the GlideScope (70%, $p < 0.05$) and LMA Fastrach (83%). Moreover the face-to-face tracheal intubation time was shorter with the Airtraq (14 ± 6) s than with the GlideScope (27 ± 18s), and Fastrach (28 ± 10s). These findings are in line of those in a study by Szarpak et al. [13], where a success rate of face-to-face intubation of a patient stuck in a vehicle was higher when using a C-MAC video laryngoscope (85.3%) than with Macintosh laryngoscope (64.7%).

The limitations of the study group include the fact that the intubation was performed by medical students; however, they are the ones who will perform a cardiovascular resuscitation without supervision. The second limitation is the fact that the study was conducted during medical simulations, not real life. However, due to the use of medical simulators, it is possible to perform cross-randomized randomized trials without harm to the potential patient [21–23] while the simulation allows us to fully standardize the procedure for scientific research.

CONCLUSIONS

In the conducted study, final-year medical students performed endotracheal intubation during a simulated cardiovascular resuscitation with higher success rate and shorter time when positioned behind the head of the patient rather than face-to-face. Further studies are needed to confirm these findings.

Conflict of interest: None declared.

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