



COMPARISON OF DIFFERENT OUT-OF-HOSPITAL AIRWAY MANAGEMENT TECHNIQUES IN PATIENTS WITH CARDIAC ARREST IN SLAVONIA REGION

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SUMMARY – Endotracheal intubation is the gold standard in inpatient treatment of cardiac arrest patients; however, there are conflicting research results in out-of-hospital conditions. This prospective study included 92 patients with confirmed cardiac arrest occurring outside a hospital facility, who fulfilled the inclusion criteria and whom the emergency ambulance team reached within 20 minutes from the event. Medical data on each patient (age, gender, cause of arrest, estimated time of arrest, time to arrival of the ambulance team, resuscitation commenced prior to arrival of the ambulance team, initial electrocardiographic rhythm, method of airway management, and success of resuscitation) were recorded. The airway maintenance techniques applied in the patients were endotracheal intubation and I-gel laryngeal mask (LMA). The rate of spontaneous circulation recovery resulting from different techniques of airway management and the incidence of spontaneous circulation recovery between the defibrillation rhythm and non-defibrillable rhythm groups were recorded for each patient. Forty-seven patients received endotracheal tube and the rest of 45 patients I-gel LMA treatment. The ratio of achieving spontaneous circulation with intubation *versus* I-gel LMA was 13 (28%) to 11 (24%) ($p=0.725$). The best return of spontaneous circulation results was recorded in patients suffering from ventricular fibrillation; however, there was no statistically significant difference between the intubation and I-gel LMA treatments (8 (47%) *vs.* 7 (41%); $p=0.916$). No statistically significant difference was observed between the outcomes of patients resuscitated by endotracheal intubation and I-gel LMA methods either.

Key words: *Cardiac arrest; Airway; Endotracheal intubation; Laryngeal mask airway*

Introduction

There are many specific features in the out-of-hospital work, especially with vitally endangered patients. Appropriate airway management will determine fur-

ther course of treatment and rule out the complications that might otherwise lead to death¹.

Endotracheal intubation (ETI) is the gold standard in airway management; however, there are no clear indicators that this indeed is the best technique in out-of-hospital conditions². Certainly, the advantage is that it keeps the airway safely isolated from exogenous substances from the oropharynx³. The I-gel laryngeal mask (LMA) requires less skill and may be easily applied in out-of-hospital conditions^{4,5}. Attempts at intubation are sometimes impractical in

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Received July 13, 2018, accepted September 12, 2018

cases of epiglottitis, pathologic conditions of the pharynx, and head and cervical spine trauma. These cases require specialist skills and highly trained and capable personnel⁶.

Nolan and Lockey emphasized that any suggestions for the use of alternative airway management techniques resulted from a small-scale sample and only a few individual researches⁷. As early as 2004, Miller warned that a classification system should be introduced in the research of alternative technique application⁸. Idris and Gabrieli stressed out the low level of protection from aspiration as an important problem⁹. In their study on 300 patients, Bamgbade *et al.* proved that the advantages of I-gel LMA over other alternative methods were quick application, minimum training requirements, and safe use¹⁰. In 2009, Schmidbauer proved the average LMA insertion time of 34 seconds, while the time required for the application of I-gel LMA was only 18 seconds¹¹. In 2011, a UK study quoted that ETI was the gold standard which, however, had its limitations in the course of cardiopulmonary resuscitation (CPR), especially in out-of-hospital conditions¹². In 2015, the new European Resuscitation Council (ERC) guidelines recommended tracheal intubation to be performed only when trained personnel are available¹³.

It is obvious that the research to date has failed to crystallize clear viewpoints and recommendations for airway management. In Croatia, there is still no established emergency medicine protocol to be followed by emergency room (ER) specialists. The emergency ambulance teams (EATs) frequently include the youngest physicians lacking the necessary experience, and especially proper ETI training. It is therefore evident that there is a need to have a method of securing the airway and ventilation appropriately without the application of ETI.

The aim of the study was to establish whether there is significant difference in the results of out-of-hospital resuscitation or return of spontaneous circulation (ROSC), depending on the airway management technique used, i.e. ETI or I-gel LMA.

Patients and Methods

This prospective study included patients with cardiac arrest that occurred outside a hospital facility. Patients with incomplete or inadequate medical records,

patients attended by the EAT after the lapse of 20 minutes, and those who did not receive any form of CPR were excluded from the study. The research was conducted in the Emergency Medicine Institute of the Brod-Posavina County, Croatia, in the period from October 1, 2014 to August 1, 2016. In total, 170 patients suffering from out-of-hospital cardiac arrest who subsequently received CPR were recorded. Subsequently excluded were those who failed to meet the above-mentioned criteria, thereby leaving altogether 92 patients in the research.

For the purpose of this study, Out-of-Hospital Cardiac Arrest Records prepared by the EAT were used. The Records included the following information: age, gender, cause of arrest, earlier conditions, estimated time of arrest, time to arrival of the EAT to the patient, initial rhythm on the monitor, defibrillation, method of managing the airway, and ROSC. The incidence of ROSC in patients ventilated using ETI or I-gel LMA was compared. The frequency of successful ROSC by individual initial rhythms appearing on the ECG was recorded. This was done in order to establish whether there was a statistically significant difference in this variable between the results of ETI and I-gel LMA application with certain types of initial ECG rhythms.

Numerical data were described by basic median and dispersion measures. The normality of distribution of the numerical variables observed was tested using the Kolmogorov-Smirnov test. Categorical variables were expressed as absolute and relative frequencies. The Mann-Whitney test was used to establish differences in the parameters measured between the two groups, and Kruskal Wallis test to establish differences among three and more groups. Differences between categorical variables were tested using the χ^2 -test and Fisher exact test. The level of significance $\alpha=0.05$ was taken to evaluate the significance of the results obtained. Statistical analysis was performed using the SPSS for Windows (version 9.0, Carry, NY, USA) software package.

The study was approved by the Ethics Committees of Dr. Josip Benčević General Hospital in Slavonski Brod and Emergency Medicine Institute of the Brod-Posavina County according to the World Medical Association outlined in the Declaration of Helsinki (Ethical principles for medical research involving human subjects). For all patients enrolled in the study, an informed consent form was signed by a family member.

Results

Ninety-two patients completed the study. Out of 92 patients, there were 64 (69.6%) male and 28 (30.4%) female patients, median age 68 (interquartile range

Table 1. Median age according to gender, resuscitation success and airway management method

Patient age (yrs), median (interquartile range 25%-57%)		P*
Gender		
Male	67.5 (55-73.3)	0.016
Female	73 (60-79.5)	
Success of resuscitation		
Yes	69.5 (58-75.5)	0.023
No	60 (51-72.5)	
Airway management method		
Endotracheal intubation	69 (57-74)	0.808
I-gel LMA	68 (56.5-77)	

LMA = laryngeal mask airway; *Mann Whitney test

Table 2. Airway management method by initial rhythm

Initial rhythm	ETI n=47 (%)	I-gel LMA n=45 (%)	P*
VF	20 (42.6)	17 (37.8)	0.640
VT	1 (2.1)	1 (2.2)	0.974
Asystole	18 (38.3)	21 (46.7)	0.417
PEA	8 (17)	6 (13.3)	0.622

*Fisher exact test; ETI = endotracheal intubation; I-gel LMA = I-gel laryngeal mask airway; VF = ventricular fibrillation; VT = ventricular tachycardia; PEA = pulseless electrical activity

(IQR) 56-75) years. The youngest patient was aged 15 and the oldest one 87 years. Females were significantly older than men ($p=0.016$), and success of resuscitation was higher in older patients ($p=0.023$) (Table 1). At the beginning of resuscitation, the initial rhythm was ventricular fibrillation in 40.6% and asystole in 44.4% of patients (Fig. 1).

Table 2 shows airway management method by the initial rhythm. No statistically significant differences were recorded between the groups. Table 3 shows resuscitation success by initial rhythm. No statistically significant differences were recorded between the groups either.

Discussion

The research compared two airway management techniques applied in out-of-hospital conditions. Out of the initial 170 patients, after necessary exclusions, the research included 92 patients. Exclusion of a relatively large number of patients shows the intention to achieve the maximum possible objectivity of the research output. None of the existing surveys led to the 2010 ERC guidelines recommending a particular technique as routine in out-of-hospital conditions. The choice of technique to be applied depends on the given situation.

The research showed that women were considerably older than men ($p=0.016$), which might have been conditioned by the selected region in which the research was conducted. No significant difference was shown between the outcome of resuscitation in patients who were resuscitated using different airway management methods ($p=0.725$). Likewise, there was

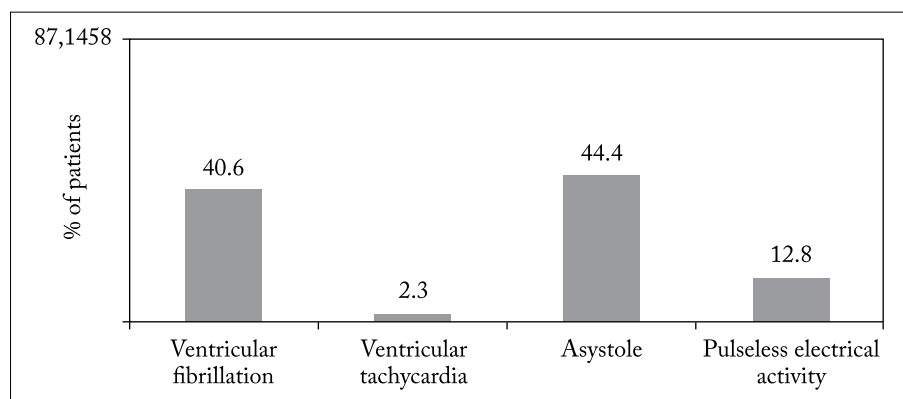


Fig. 1. Distribution of patients (%) by initial rhythm.

Table 3. Resuscitation success by initial rhythm

Initial rhythm	Successful n (%)			Unsuccessful n (%)		
	ETI n=13	I-gel LMA n=11	P*	ETI n=34	I-gel LMA n=34	P*
VF	8 (61.5)	7 (63.6)	0.916	9 (26.5)	10 (29.4)	0.787
VT	1 (7.6)	1 (9.1)	0.903	2 (5.8)	1 (2.9)	0.554
Asystole	2 (15.3)	1 (9.1)	0.642	19 (55.9)	18 (52.9)	0.808
PEA	2 (15.3)	2 (18.2)	0.853	4 (11.8)	5 (14.7)	0.720

* χ^2 -test; ETI = endotracheal intubation; I-gel LMA = I-gel laryngeal mask airway; VF = ventricular fibrillation; VT = ventricular tachycardia; PEA = pulseless electrical activity

no statistically significant difference in the incidence of ROSC in any of the arrest ECG rhythms, which points to the conclusion that I-gel LMA may be used as a substitute method in lieu of the ETI method, irrespective of the initial cardiac rhythm.

The ETI method might well be the gold standard in airway management; however, to be skillfully applied, it requires extensive practice and experience¹⁴. Moreover, the time needed for the application of the ETI method is considerably longer than that required to apply the I-gel LMA, the latter therefore presenting itself as a valuable replacement method in the researched conditions in this region of Slavonia. Our country still does not have an established emergency medicine protocol to be followed by ER specialists. The EATs frequently consist of the youngest physicians lacking the necessary experience, who are incapable of intubating skillfully and safely. They should therefore have a good substitute technique instead of the ETI, and the results of this study show that I-gel LMA is exactly that. The research results also corroborated the thesis that the best results in resuscitation were achieved in patients with defibrillable rhythms. This is certainly due to the use of high quality defibrillators, deployment of field teams, quick arrival to the patient, and good work of medical dispatchers, who operate in accordance with the Croatian Emergency Patient Treatment index and give callers clear telephone instructions as to what to do until the closest EAT arrives. Quick defibrillation should be the primary goal of each EAT in any out-of-hospital cardiac arrest case.

The research might have been limited by the fact that relevant data were recorded only until the ROSC

or patient admission to the hospital, without following up further treatment and success in patient recovery.

Conclusions

No significant difference in the incidence of ROSC was proven to depend on the airway management technique, irrespective of the initial rhythm in cardiac arrest. The ETI technique requires practice and experience. In out-of-hospital conditions, we recommend the I-gel LMA airway management technique because of its simplicity, shorter training periods, and safe application, in particular in case of less experienced physicians.

Acknowledgment

This study was financially supported by the Emergency Medicine Institute of the Brod-Posavina County and Dr. Josip Benčević General Hospital, Slavonski Brod, Croatia.

References

1. Majerić-Kogler V, Kilibarda Bošan I. Održavanje dišnog puta i mehanička ventilacija u izvanbolničkim uvjetima. Zagreb: Medicinska naklada; 2011. (in Croatian)
2. European Resuscitation Council. Priručnik za napredno održavanje života. 6th edn. Zagreb; 2010. (in Croatian)
3. Karatzanis AD, Vardouniotis A, Moschandreas J. The risk of foreign body aspiration in children can be reduced with proper education of the general population. *Int J Pediatr Otorhinolaryngol.* 2007;71(2):311-5. DOI: 10.1016/j.ijporl.2006.10.020
4. Campbel JE. International Trauma Life Support for Prehospital Care Providers. 6th edn. New Jersey: American College of Emergency Physicians; 2008.

5. Braithwaite E. Evaluation of a new supraglottic airway: the i-gel. Unpublished 2006. Intersurgical Ltd., Berkshire, UK.
6. Jackson KM, Cook T. Evaluation of four airway training manikins as patient simulators for the insertion of eight types of supraglottic airway devices. *Anaesthesia*. 2007;62:388-93. DOI: 10.1111/j.1365-2044.2007.04983.x
7. Nolan JP, Lockey D. Airway management for out-of-hospital cardiac arrest – more data required. *Resuscitation*. 2009;80:1333-4. DOI: 10.1016/j.resuscitation.2009.11.001
8. Miller DM. A proposed classification and scoring system for supraglottic sealing airways. *Anesth Analg*. 2004;99:1553-9. DOI: 10.1213/01.ANE.0000134798.00069.2B
9. Idris AH, Gabrielli A. Advances in airway management. *Emerg Med Clin North Am*. 2002;20:843-57. DOI: 10.1016/S0733-8627(02)00031-7
10. Bamgbade OA, Macnab WR, Khalaf WM. Evaluation of the i-gel airway in 300 patients. *Eur J Anaesthesiol*. 2008;25(10):865-6. DOI: 10.1017/S0265021508004511
11. Schmidbauer W, Bercker S, Volk T. Oesophageal seal of the novel supralaryngeal airway device i-gel in comparison with the laryngeal mask airways Classic and ProSeal using a cadaver model. *Br J Anaesth*. 2009;102(1):135-9. DOI: 10.1093/bja/aen319
12. Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Major complications of airway management in the UK. Report & findings, 2011.
13. Soar J, Nolan JP, Böttiger BW, *et al.* European Resuscitation Council Guidelines for Resuscitation 2015. Section 3. Adult advanced life support. *Resuscitation*. 2015;95:100-47.

Sažetak

USPOREDBA RAZLIČITIH METODA IZVANBOLNIČKOG ODRŽAVANJA DIŠNOGA PUTA U BOLESNIKA SA SRČANIM ZASTOJEM U SLAVONSKOJ REGIJI

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Endotrahealna intubacija je „zlatni standard“ u liječenju bolesnika sa srčanim zastojem u bolnici, ali rezultati istraživanja u izvanbolničkim uvjetima su proturječni. U ovo istraživanje bila su uključena 92 bolesnika sa srčanim zastojem doživljenim u izvanbolničkim uvjetima, koji su ispunjavali kriterije uključenja u studiju te kod kojih je hitna medicinska pomoć stigla unutar 20 minuta od srčanog zastoja. Bilježeni su sljedeći podatci: spol, dob, uzrok srčanog zastoja, vrijeme srčanog zastoja, vrijeme do dolaska ekipe hitne pomoći, započinjanje reanimacije prije dolaska ekipe hitne pomoći, početni elektrokardiografski ritam, metoda osiguravanja dišnog puta te uspješnost postupka reanimacije. Od tehnika održavanja dišnog puta rabila se I-gel laringealna maska te endotrahealni tubus. Bilježeni su rezultati povrata spontane cirkulacije kod pojedine metode održavanja dišnog puta te razlike između skupina s obzirom na ritmove koji se defibriliraju i one koji se ne defibriliraju. Bila su 47 bolesnika s endotrahealnim tubusom, dok je 45 bolesnika imalo laringealnu masku. Omjer povrata spontane cirkulacije između skupine s intubacijom i skupine s laringealnom maskom bio je 13 (28%) prema 11 (24%) ($p=0,725$). Najbolji rezultati oživljavanja zabilježeni su u skupini bolesnika s ventrikulskom fibrilacijom, ali bez statistički značajne razlike između skupine s endotrahealnom intubacijom i skupine s laringealnom maskom (8 (47%) prema 7 (41%); $p=0,916$). Nije pronađena statistički značajna razlika u uspješnosti oživljavanja između skupine bolesnika s endotrahealnom intubacijom i skupine s laringealnom maskom.

Cljučne riječi: Srčani zastoj; Dišni put; Endotrahealna intubacija; Laringealna maska