Comparison of direct intubation and Supraglottic Airway Laryngopharyngeal Tube (S.A.L.T.) for endotracheal intubation during cardiopulmonary resuscitation. Randomized manikin study

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Abstract

Background: Airway control is a potentially lifesaving procedure, but intubation by direct laryngoscopy may be difficult. The aim of this study was to assess the success rate of tracheal intubation using the Macintosh laryngoscope and Supraglottic Airway Laryngopharyngeal Tube (S.A.L.T.) device.

Methods: This is a randomised cross-over study involving 120 paramedics utilising the Macintosh laryngoscope and S.A.L.T. during simulated cardiopulmonary resuscitation (CPR) on a manikin. We compared times to successful intubation and intubation success rates for intubation using Macintosh and S.A.L.T. performed by paramedics, during CPR with and without chest compression.

Results: Mean intubation times for conventional laryngoscopic intubation and S.A.L.T. without chest compressions were 31.52 ± 7.23 s and 17.97 ± 5.33 s, respectively (P < 0.001).

Conclusions: Intubation via the S.A.L.T. was more successful than conventional laryngoscopic intubation, regardless of whether chest compressions were interrupted or not.

Key words: cardiopulmonary resuscitation; laryngoscopy, Macintosh laryngoscope; S.A.L.T.; paramedic

Provision of a patent airway should be one of the fundamental skills of emergency medical technicians (EMT). During sudden cardiac arrest (SCA), oxygen reserves last for 3−5 minutes [1]. After this period, irreversible hypoxia-induced changes develop in vital organs, including the central nervous system and myocardium [2]. Immediate indirect heart massage, provision of patent upper airway (UA) and pulmonary ventilation are the key elements of lifesaving management [3].

The basic technique of non-instrumental provision of UA patency is a double hand manoeuvre (forehead-chin or forehead-mandible); when a cervical spine injury is suspected, the Esmarch manoeuvre is performed. However, the above-mentioned methods, which enable pulmonary ventilation during SCA, are not optimal [4]. According to the European Resuscitation Council (ERC) guidelines, the best method to provide patent airways during SCA is endotracheal intubation (ETI) [1]. Besides providing airway patency, the method protects against regurgitation and aspiration of gastric contents.

During trainings, EMTs are instructed how to intubate with a Macintosh laryngoscope. However, it should be remembered that intubation could be associated with numerous complications, including damage to or breaking off teeth, introduction of the tube to the right bronchus or oesophagus. A prolonged intubation attempt can have fatal consequences, and too rapid introduction of the endotracheal tube is likely to damage internal structures of the nasopharynx resulting in consequent bleeding. Besides the complications mentioned above, a seemingly “standard” endotracheal intubation during resuscitation can be associated with some factors hampering its execution, such as unintended movements of the patient during indirect heart massage, a difficult airway or hindered access to the
patient’s head. In such cases, the methods which enable “blind” endotracheal intubation can prove helpful [5, 6].

The aim of the present study was to compare the effectiveness of two methods of endotracheal intubation performed during simulated SCA on a manikin.

METHODS

The study was performed between April and May 2014. One hundred and twenty paramedics participating in the training session organised by the International Institute of Rescue Research and Education, were randomly enrolled. Although all the participants had previous experience in working with the Macintosh laryngoscope, none had used the Supraglottic Airway Laryngopharyngeal Tube (S.A.L.T.).

At the beginning of the study, all the paramedics underwent 45-minute training in airway anatomy and were informed about the intubation options - with the Macintosh laryngoscope and S.A.L.T. device. The participants practiced a traditional direct laryngoscopy-guided and “blind” intubation with the S.A.L.T. device (until the attempt was successful).

The following devices were used: the Macintosh laryngoscope with blade no. 3 (New Waseem Trading Co., Pakistan), the S.A.L.T. device (ECOLAB®, Alpharetta, GA, USA), the endotracheal tube with a Soft-Seal® cuff and the “Murthy eye” - 7.0 mm I.D. (Portex, UK). The participants performed intubations for simulated SCA on a METIman Prehospital manikin (CAE HealthCare, USA).

The order of endotracheal intubations (laryngoscope or S.A.L.T.) was determined using a Research Randomizer [7]. The group of 120 participants was divided into 4 subgroups after intubation, each participant had a 30-minute break and then was asked to perform ETI using another method. The detailed randomized procedure was presented in Figure 1.

The data were analysed using R statistical software for Windows (version 3.0.0). The results were presented as a mean ± SD or percentage. Either the Fisher or Mann-Whitney-Wilcoxon test was applied for comparison. The level of statistical significance was set at P < 0.05.

RESULTS

The study encompassed 120 EMTs, including 46 women and 74 men. Thirty-nine of them worked in hospital emergency departments and 81 in ambulance emergency rescue teams. The mean age was 31.2 ± 5.6 years and work experience — 8.2 ± 5.2 years. The mean number of ETIs performed with a Macintosh laryngoscope during services was 12 ± 4.

The mean times of intubation with the standard method (Macintosh laryngoscope) and using S.A.L.T. are presented in Table 1. The duration of ETI during indirect heart massage (IHM) was found to be longer, compared to cases in which chest compressions were interrupted during intubation. The mean time of intubations with the traditional method during chest compressions was 39.43 ± 8.23 sec and was statistically significantly longer than in cases with IHM interruptions (31.52 ± 7.23 sec, P < 0.001).

A similar correlation was observed for S.A.L.T. intubation. The mean time of intubation without IHM interruptions was 20.42 ± 7.54 sec and with IHM interruptions — 17.97 ± 5.33 sec (P < 0.005). The success rate of the first intubation attempt using a laryngoscope during IHM was 65.42%, whereas during a short interruption in IHM it was 76.54% (P = 0.184). The percentages for S.A.L.T. were 82% and 91%, respectively (P = 0.219).

The success rate of ML and S.A.L.T. intubation with IHM and with IHM interruptions showed statistically significant differences. The success rate of ML intubation with IHM was 71.23% while with chest compression interruptions it was 82.45% (P = 0.0427). For S.A.L.T., the results were 84.33% and 96.23%, respectively (P = 0.0311). A comparison of the effectiveness of intubation using the laryngoscope (82.45%) and S.A.L.T. (96.23%) with interruptions in chest compressions demonstrated statistically significant differences (P = 0.0372). Likewise, in cases where CPR was carried out simultaneously with an intubation attempt, a statistically significant difference in the effectiveness of S.A.L.T. and ML intubation was observed (P = 0.0455).

DISCUSSION

Endotracheal intubation is the gold standard for the provision of patent upper airway, both in children and adults [1]. Performed during CPR, it enables asynchronous resuscitation procedures (separately — ventilation and chest compressions) with a compression rate of 100–120 min⁻¹ and a respiration rate of 8–10 min⁻¹ [4, 6].

The use of a Macintosh laryngoscope is considered the traditional method of endotracheal intubation, in which the insertion of endotracheal tube is eye guided. In the case of S.A.L.T., the introduction of the tube is “blind,” which means that the person performing the procedure does not visualize vocal cords and the superior aperture to the larynx.

The indications for intubation include situations, in which maintenance of proper lung ventilation (e.g. using supraglottic devices) is not possible or prolonged supportive ventilation is anticipated (as during CPR) [1, 3].
The literature reports demonstrate that the medical personnel working at various levels of care manage endotracheal intubation differently, particularly in cases of difficult intubation [8-10]. The most common complication of intubation is undiagnosed intubation of the oesophagus. Moreover, improper intubation can cause severe damage to the soft tissues or hypoxic damage to the CNS [11]. To avoid complications and reduce their risk, alternative methods of patency restoration can prove useful, i.e. with the devices allowing "blind" intubation or with a video laryngoscope. In our study, the success rate of the first intubation attempt using the Macintosh laryngoscope was 65.42% with IHM and 75.64% with interruptions in chest compressions. Our result were better than reported by Narang et al. — 23% [12], Mitterlechner et al. — 32.35% [13], Peters et al. — 40.8% [8], Timmermann et al. — 50.4% [10], and O’Donnell et al.
Table 1. Time of intubation depending on the method of intubation and indirect heart massage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Intubation (sec)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of intubation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laryngoscope</td>
<td>38.41 ± 8.11</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>S.A.L.T.</td>
<td>18.75 ± 6.44</td>
<td></td>
</tr>
<tr>
<td>Indirect heart massage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30.32 ± 2.63</td>
<td>&lt; 0.005</td>
</tr>
<tr>
<td>No</td>
<td>21.23 ± 3.28</td>
<td></td>
</tr>
</tbody>
</table>

— 62% [14]. In Lódz study, conducted in the Lódz centre, the success rate of the first intubation using the Macintosh laryngoscope was 96.6% [15]. The mean time of intubation using the laryngoscope in our study was 38.41 ± 8.11 sec and was different from the results of other authors, i.e. 58 ± 27 sec — Mitterlechner [13] and 89.1 ± 23.3 sec — Timmermann [16].

An alternative to the standard Macintosh laryngoscope can be devices for „blind” intubation, including the S.A.L.T. device used in our study, the Cobra perilyngeal airway (PLA) or laryngeal mask. Numerous studies have demonstrated the effectiveness of these devices used for “blind” intubation in patients with difficult instrumental restoration of UA patency [13, 17–19]. Our findings proved the higher effectiveness of S.A.L.T. intubation, both with IIM and with interruptions in chest compressions. Furthermore, the duration of S.A.L.T. intubation was significantly shorter than in direct laryngoscopy — 18.75 ± 6.44. According to Anand et al. [20], this time was 26.3 ± 19.0 sec, while the success rate of endotracheal intubations under clinical conditions was 40%. In a study carried out in Columbia, 90% of participants performed a successful intubation using S.A.L.T. in less than 16 sec [21]. In our study, the success rate of the first „blind” intubation attempt through S.A.L.T. with heart massage was 82% whereas without IIM it was 91%. Moreover, our results are better than those reported by Bledsoe et al. which were 48.1% [22].

CONCLUSION

The effectiveness of S.A.L.T. intubation during CPR is found to be higher, compared to direct LM laryngoscopy.

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