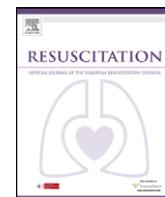




Contents lists available at ScienceDirect



Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Simulation and education

A suction laryngoscope facilitates intubation for physicians with occasional emergency medical service experience—A manikin study with severe simulated airway haemorrhage^{☆,☆☆}

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ARTICLE INFO

Article history:

Received 25 September 2008

Received in revised form 11 February 2009

Accepted 10 March 2009

Available online xxx

Keywords:

Airway

Haemorrhage

Laryngoscope

Physician

Suction

ABSTRACT

Introduction: We developed a suction laryngoscope, which enables simultaneous suction and laryngoscopy in cases of airway haemorrhage and evaluated its potential benefits in physicians with varying emergency medical service experience.

Methods: Eighteen physicians with regular and 24 physicians with occasional emergency medical service experience intubated the trachea of a manikin with severe simulated airway haemorrhage using the suction laryngoscope and the Macintosh laryngoscope in random order.

Results: In physicians with regular emergency medical service experience, there was neither a difference in time needed for intubation [median (IQR, CI 95%): 34 (18, 30–46) vs. 34 (22, 30–52) s; $P=0.52$, nor in the number of oesophageal intubations [0/18 (0%) vs. 3/18 (16.7%); $P=NS$] when using the suction vs. the Macintosh laryngoscope. In physicians with occasional emergency medical service experience, there was no difference in time needed for intubation [median (IQR, CI 95%): 42 (25, 41–57) vs. 45 (33, 41–65) s; $P=0.56$, but the number of oesophageal intubations was significantly lower when using the suction laryngoscope [4/24 (16.7%) vs. 12/24 (50.0%); $P=0.04$].

Conclusions: In a model of severe simulated airway haemorrhage, employing a suction laryngoscope significantly decreased the likelihood of oesophageal intubations in physicians with occasional emergency medical service experience.

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1. Introduction

Recent cases of field airway management disasters in both physician- and paramedic-based emergency medical services demonstrate the importance of excellent intubation skills and the serious complications of unrecognised oesophageal intubation.^{1,2} Important mechanisms posing intubation problems may be oropharyngeal bleeding or massive regurgitation of stomach contents, when the view of the glottis may be obstructed, or even completely blocked by fluids. During ongoing bleeding or regurgitation, the rescuer has to alternate handling suctioning and the tracheal tube during the intubation maneuver, which may be extremely difficult for an inexperienced rescuer.

A non-commercial suction laryngoscope enabling simultaneous laryngoscopy and suctioning has been shown to decrease the likelihood of oesophageal intubation in medical students having little intubation experience limited to manikins,³ but was never tested in physicians.

The purpose of this study was to evaluate a possible benefit of the suction laryngoscope compared with a standard Macintosh laryngoscope in the hands of physicians working regularly in the emergency medical service system, compared with physicians with occasional experience in the emergency medical service system. Our null hypothesis was that both devices would result in comparable results using the end points of duration to successful intubation and number of oesophageal intubations.

2. Materials and methods

2.1. Subjects

Volunteers in this study were 42 physicians taking part in an emergency medicine refresher-course. All physicians were certified for the emergency medical service. Eighteen had regular emergency

[☆] A Spanish translated version of the summary of this article appears as Appendix in the final online version at doi:[10.1016/j.resuscitation.2009.03.004](https://doi.org/10.1016/j.resuscitation.2009.03.004).

^{☆☆} Supported, in part, by the Austrian National Bank Science Foundation grant 11448, Vienna, Austria.

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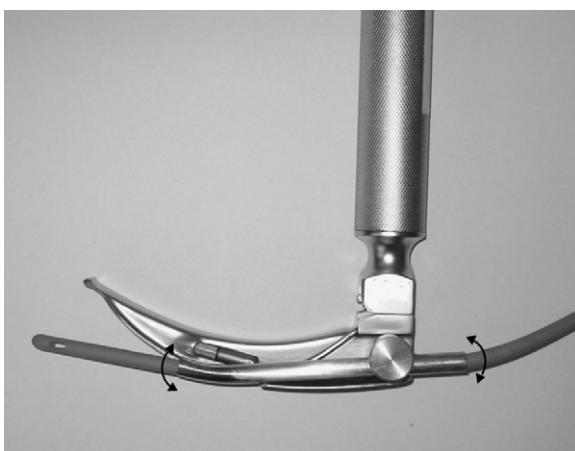


Fig. 1. The suction laryngoscope. A 20 French suction catheter can be inserted through the adjustable stainless steel-guide tube.

medical service experience while professionally responding with an emergency medical service unit to field emergencies. Twenty-four did not professionally respond with an emergency medical service and had only occasional emergency medical service experience, a one week-course for acquiring and every two years a refresher-course, which is the minimum for maintaining their certification for the emergency medical service.

2.2. Technical information

In an established model of a simulated severe airway bleeding scenario, we compared a newly developed suction laryngoscope³ (Fig. 1) with a Macintosh laryngoscope (size 3). Our suction laryngoscope consists of a stainless steel-guide tube that is fixed at the lingual surface of a standard Macintosh laryngoscope blade size 3, which allows insertion of a suction catheter with a large lumen (Rüsch, 20 French, Kernen, Germany). The suction catheter can be moved backwards and forwards through the stainless steel-guide tube. Fixed at one pivotal point at the laryngoscope, the stainless steel-guide tube can be turned around this point in the vertical line to optimise catheter placement. The tip of the guide does not protrude beyond the blade in order to minimise risk of injuring pharyngeal mucosa, and not to obstruct the laryngeal view. In a resuscitation manikin (Economy Adult Airway Management Trainer, Simulaids, Inc., Woodstock, NY), severe haemorrhage in the upper pharynx was simulated with black coffee running continuously into the nasopharynx via tubes fixed in the nostrils with a standardised flow of 500 mL/min.

2.3. Test procedure

After handling of the suction laryngoscope was demonstrated and the airway bleeding model was introduced to the participants, they were asked to intubate the manikin's trachea with an 8.5 mm internal diameter cuffed tracheal tube with the suction laryngoscope, or with a standard Macintosh laryngoscope in random order. Both groups used the same suction catheters (Rüsch, 20 French, Kernen, Germany) being connected to the same vacuum source (0.8 bar). The time from touching the laryngoscope until placement of the tracheal tube was measured with a stopwatch. Placement of the tracheal tube was controlled by assessing lung ventilation via the tube with a bag-valve-device by the investigators. The number of successful vs. unsuccessful intubation attempts was then recorded.

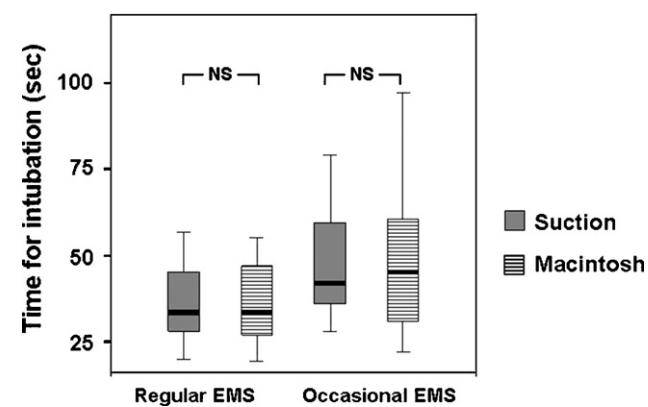


Fig. 2. Time (s) needed for intubation in physicians with either regular or occasional emergency medical service (EMS) experience using the suction laryngoscope vs. the Macintosh laryngoscope.

2.4. Statistics

All data is given as median (IQR, CI 95%). Kolmogorov-Smirnov-Test was used to test for normal distribution of continuous parameters. Due to significant departure from normality at an alpha-level of 0.05, duration of intubation attempts was analysed using non-parametric Wilcoxon test for paired samples in order to additionally account for the repeated measurement structure of our data. Intubation success was analysed using McNemar test. $P < 0.05$ was considered statistically significant. Statistical analysis was performed using SPSS 15.0 statistical package (SPSS, Chicago, IL).

3. Results

Accounting all physicians, there was no difference in time needed for intubation when using the suction laryngoscope vs. the Macintosh laryngoscope [median (IQR, CI 95%): 39 (24, 39–50) vs. 40 (25, 39–56) s; $P = 0.40$], but a lower number of oesophageal intubations when using the suction laryngoscope [4/42 (9.5%) vs. 15/42 (35.7%); $P = 0.01$].

In physicians with regular emergency medical service experience, there was no difference in time needed for intubation when using the suction laryngoscope vs. the Macintosh laryngoscope [median (IQR, CI 95%): 34 (18, 30–46) vs. 34 (22, 30–52) s; $P = 0.52$] (Fig. 2), and no difference in the number of oesophageal intubations [0/18 (0%) vs. 3/18 (16.7%); $P = \text{NS}$] (Fig. 3). In physicians with occasional emergency medical service experience, there was no difference in time [median (IQR, CI 95%): 42 (25, 41–57) vs. 45 (33, 41–65) s; $P = 0.56$] (Fig. 2), but a lower number of oesophageal intu-

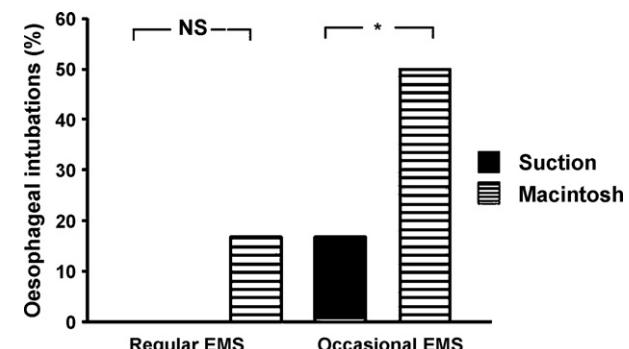


Fig. 3. Oesophageal intubations (% of intubation attempts) in physicians with either regular or occasional emergency medical service (EMS) experience using the suction laryngoscope vs. the Macintosh laryngoscope; * indicates $P < 0.05$.

bations when using the suction laryngoscope [4/24 (16.7%) vs. 12/24 (50.0%); $P=0.04$] (Fig. 3).

4. Discussion

Suction laryngoscopes have been previously developed^{4–12} to facilitate intubation in cases of upper airway haemorrhage, or massive regurgitation of stomach contents. However, only thin and stiff suction catheters have been used when adapting the aforementioned laryngoscopes, resulting in an inadequate suction rate. Therefore, these laryngoscopes have not become widely accepted, and were never marketed commercially. Our non-commercial suction laryngoscope³ is a novel approach to combine both facilitated laryngoscopy, and powerful suction ability.

Although the time needed for intubation in this study was comparable between devices, oesophageal intubations were more likely in physicians with occasional emergency medical service experience, when using the Macintosh laryngoscope compared with the suction laryngoscope. The most likely mechanism for this phenomenon was that physicians with occasional emergency medical service experience were handicapped by alternating from the suction catheter to inserting the tracheal tube, while the glottis view was re-obstructed by fluids, rendering oesophageal intubation with the Macintosh laryngoscope more likely. Physicians with regular emergency medical service experience, however, performed intubation faster, thus they were less impaired by an obstructed view of the glottis by fluids, independently of the laryngoscope types being used.

Unfortunately, it cannot be always ensured that emergency medical service personnel have excellent clinical airway management skills.^{2,13} Since airway-related complications increase with the number of laryngoscopy attempts in a given patient,¹⁴ rapid, initial successful intubation is important. If intubation is not possible, other airway devices such as the laryngeal mask airway should be used.¹⁵ A German study showed an average of only three to nine performed intubations per year per physician in physician-manned ground emergency medical service systems,¹³ indicating that non-anaesthesia or non-ICU physicians may have intubation problems in difficult situations because of lack of daily experience in key interventions. The suction laryngoscope does not claim to solve these problems, as no airway device will ever be able to compensate for insufficient airway management education or lack of clinical skills. Nevertheless, the suction laryngoscope could be a helpful device in difficult airway scenarios for healthcare personnel without daily invasive airway management experience.

Some limitations need to be noted. First, intubating a mechanical model cannot be directly extrapolated to a real clinical situation without further investigation. However, in order to prevent harm to patients, we did not want to use a new airway device in humans until its benefit has been validated in a model. Clinical assessment in patients needs to follow, although a randomised study in the emergency setting may be difficult. Lastly, due to possible infec-

tious disease problems and to avoid changing intubation conditions because of coagulation effects, we used coffee instead of blood and vomitus in our model.

5. Conclusions

The suction laryngoscope decreased the likelihood of oesophageal intubations by physicians with occasional emergency medical service experience in a manikin simulating severe oropharyngeal haemorrhage.

Conflict of interest

No author has any conflict of interest in regard of devices or methods described in this article.

Funding

Supported, in part, by the Austrian National Bank Science Foundation grant 11448, Vienna, Austria.

Acknowledgment

We are indebted to Fritz Zschiegner for technical advice.

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