American Journal of Emergency Medicine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

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

Comparison of Xenon with LED illuminant in difficult and inhalation injury airway scenario: A randomized crossover manikin study

Andreas Moritz, MD *, Johannes Prottengeier, MD, Joachim Schmidt, MD

Department of Anesthesiology, University Hospital Erlangen, Krankenhausstrasse 12, 91054 Erlangen, Germany

ARTICLE INFO

Article history:
Received 26 March 2017
Received in revised form 4 May 2017
Accepted 8 May 2017
Available online xxxx

Keywords:
Inhalation trauma
Difficult airway
Intubation
Manikin
Laryngoscope illuminant

ABSTRACT

Purpose: The purpose of this study was to compare the effectiveness of a Xenon halogen with a light-emitting diode (LED) laryngoscope light handle in a difficult airway scenario, as well as in an inhalation injury airway scenario that combines a difficult airway and a limited view.

Methods: We recruited forty-two anesthetists into a randomized crossover trial. Each performed tracheal intubation (TI) with a Xenon halogen and a LED light handle in the two manikin scenarios. The primary endpoint was the "time to intubate". Other endpoints were the "time to vocal cords", the "time to ventilate", the rate of successful intubation, the number of intubation attempts, the Cormack-Lehane score, the number of optimization maneuvers, the number of audible dental click sounds indicating dental damage and subjective impressions.

Results: In the difficult airway scenario, no significant differences in the recorded intubation times were observed. In the inhalation injury airway scenario, the intubation times were significantly shorter using the LED light handle. Regarding the subjective values, the LED illuminant enabled a significant better view and illumination of the oropharyngeal space and the vocal cords, in both manikin scenarios.

Conclusion: The LED laryngoscope light handle did not affect the recorded intubation times in the simulated difficult airway scenario, but provided significant advantages in the inhalation injury airway scenario that combines a difficult airway with a limited view caused by a sooted pharynx. We therefore hypothesize, that the LED illuminant might be beneficial in the airway management of burn patients with severe inhalation injury.

1. Introduction

Inhalation injury has become the most frequent cause of death in acute phase of burn patients [1] and it is often associated with a difficult airway caused by facial edema, acute upper airway obstruction [2] and the presence of soot in the pharynx [3]. Thus airway management in burn patients represents a clinical challenge, even in the hands of board-certified anesthesiologists [4]. Complications arising from difficult or failed tracheal intubation remain a leading cause of anesthesia associated morbidity and mortality [5]. Moreover, repeated intubation attempts are associated with decreased success rates on the first rescue intubation in the emergency department [6], transportation delays, longer hospital stays, worse neurologic outcomes [7] and increased mortality [8]. Therefore, the equipment for tracheal intubation in burn patients with severe inhalation trauma should meet the highest requirements.

Multiple laryngoscope characteristics, including blade size, length and shape, are known to affect intubation success [9]. The laryngoscope illumination is another important variable and may be crucial to successful tracheal intubation. Multiple factors influencing the light intensity have already been identified. Milne and colleagues, for example, examined the effects of different laryngoscope light handles on the light intensity from disposable laryngoscope blades [10]. However there are enormous variations in illumination provided by reusable and disposable laryngoscope blades [11-13]. Several articles have proposed minimum or optimum laryngoscope light intensity requirements for intubation with a wide range of reported values: minimum 597 lx [14], 700 lx [15], 867 lx [16], optimum 200–1938 lx [17]. The initial draft of the lighting standard from the International Organization for Standardization (ISO) had proposed a minimum of 700 lx [13,15,17]. However, Moore and colleagues showed, in a non-modified airway manikin study, that the intensity of laryngoscope light, over three clinically feasible levels of light strength, did not affect the time to successful intubation [18]. Akihisa and colleagues demonstrated that the use of a light-emitting diode (LED) laryngoscope light handle provided superior conditions for intubation with a plastic single-use blade and improved intubation performance comparative to that of a metal reusable blade during simulated CPR of an infant manikin [19]. However, to our knowledge no previous study has examined the effects of different laryngoscope illuminants on intubation neither in a difficult nor in an inhalation injury airway scenario, yet. Thus, the purpose of this study was to compare the effectiveness of a Xenon halogen with a LED

* Corresponding author.
E-mail address: andreas.moritz@kfa.imed.uni-erlangen.de (A. Moritz).

http://dx.doi.org/10.1016/j.ajem.2017.05.008
0735-6757/© 2017 Elsevier Inc. All rights reserved.

laryngoscope light handle in a simulated difficult airway scenario caused by a rigid cervical collar as well as in a simulated inhalation injury airway scenario that combines a difficult airway caused by a rigid cervical collar and a limited view caused by a sooted pharynx.

2. Methods

2.1. Study design and setting

Forty-two anesthetists with a median clinical experience of 4.3 years (inter-quartile range (IQR): 2.5–6) participated in this randomized crossover trial. Data were anonymized and information on the performance of individual participants was not made available to anybody outside the research team. We notified the study to the local ethics committee (Ethics Committee of the Friedrich-Alexander University Erlangen-Nürnberg). The ethics committee waived a formal submission for approval.

Each anesthetist performed tracheal intubation with a laryngoscope system containing a 3.5 V Xenon halogen bulb (reusable x-lite Macintosh laryngoscope blade size 3, Wirutec Rüsch Medical Vertriebs GmbH, Sulzbach, Germany; Heine Standard F.O. XHL metallic laryngoscope handle, Heine Optotechnik GmbH & Co. KG, Herrsching, Germany) and with a laryngoscope system containing a 3.5 V LED illuminant (reusable x-lite Macintosh laryngoscope blade size 3, Wirutec Rüsch Medical Vertriebs GmbH, Sulzbach, Germany; Heine Standard F.O. 4 LED NT metallic laryngoscope handle, Heine Optotechnik GmbH & Co. KG, Herrsching, Germany) in a difficult airway scenario manikin (Fig. 1) (Laerdal Medical AS, Stavanger, Norway) as well as an inhalation injury airway scenario manikin (Fig. 2) (Erlanger-Inhalation Injury-Manikin, a modified Laerdal Medical AS manikin [20]).

To simulate an inhalation injury, we used the previous published Erlanger-Inhalation Injury-Manikin [20]. The pharynx of this manikin was pigmented with activated carbon (Fig. 3). The neck of both manikins was fixed in a neutral position by a rigid cervical collar and thus the distance between the free edge of the upper and lower incisors (interdental distance) was limited. These conditions turned it into a difficult intubation model [21].

The order in which the manikins were tested was randomized by opening two sealed opaque envelopes containing the names of the manikins. The sequence of laryngoscope handle use was also randomized for each scenario by using two sealed opaque envelopes containing the names of the laryngoscope illuminants.

Fig. 1. Laerdal Airway Management Trainer. The difficult airway is simulated by cervical immobilization applying a cervical collar.

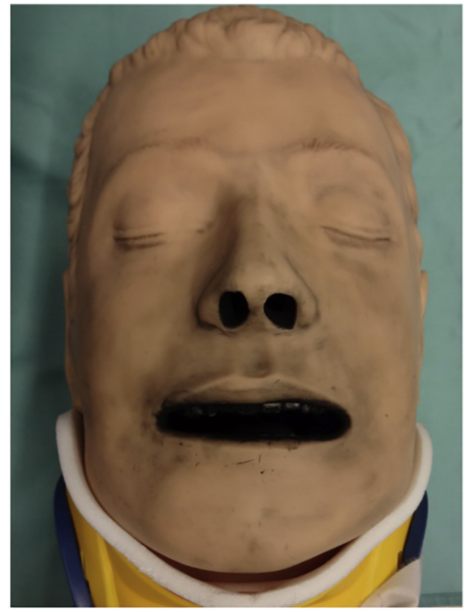

Fig. 2. Erlanger-Inhalation Injury-Manikin, a modified Laerdal Airway Management Trainer. The difficult airway is simulated by cervical immobilization applying a cervical collar. The pharynx is pigmented with activated carbon [20].

Thermal injury to supraglottic structures results in edema and can rapidly lead to upper airway obstruction [22]. Therefore all intubations were performed with a 6.0 mm cuffed endotracheal tube (ETT; Super Safetyclear endotracheal tube, I.D. 6.0 mm, Wirutec Rüsch Medical Vertriebs GmbH, Sulzbach, Germany). Before each intubation attempt, a reusable endotracheal tube introducer was inserted into the ETT. The cuff was lubricated with a silicone spray and the cuff was inflated and deflated with a 10 ml syringe.

2.2. Measurements

2.2.1. Objective findings

The primary endpoint was the “time to intubate”. Esophageal intubations, attempts requiring >120 s and >2 attempts were recorded as failed intubation attempts. All time measurements were made by the same person by direct observation with a stopwatch to avoid interobserver error.

Fig. 3. Oropharynx of the Erlanger-Inhalation Injury-Manikin. To simulate an inhalation injury the pharynx is pigmented with activated carbon.

Please cite this article as: Moritz A, et al, Comparison of Xenon with LED illuminant in difficult and inhalation injury airway scenario: A randomized crossover manikin study, American Journal of Emergency Medicine (2017), http://dx.doi.org/10.1016/j.ajem.2017.05.008