Difficult Airway Simulation for Novice Physicians: A Randomized Trial Comparing Traditional Laryngoscopy and Video Assisted Laryngoscopy

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Methods

Introduction

Direct laryngoscopy with endotracheal intubation is an advanced airway technique requiring substantial training and frequent clinical experience to maintain effective competence. A limited number of medical specialties, to include Anesthesiology, Emergency Medicine, Critical Care, and Otolaryngology-Head & Neck Surgery provide ample training for consistent performance of this procedure. Previous studies testing inexperienced medical personnel have shown initial endotracheal intubation success rates between 35-45% in both manikin and live subjects. Video laryngoscopy has been previously shown to increase these rates in normal manikin airways at or above 90%.

Currenly, both the Department of Defense and other governmental agencies to include the Center for Disease Control, Federal Bureau of Investigation, and U.S. Park Police utilize direct laryngoscopy and video-assisted laryngoscopy in emergency settings. The video-assisted laryngoscope blade employs the use of a camera near the distal tip of the laryngoscope blade with a corresponding LCD display; no lifting force, however, is required for visualization.

The goals of this study are to evaluate whether novice physicians have a significant advantage in an difficult airway scenario that may mimic a trauma scenario. The specific objectives of this study include evaluation of intubation success and time to intubation, as well as subjective evaluation of performance using both direct and video-assisted laryngoscopy.

Methods

• First year residents across a variety of disciplines (categorical interns of medical and surgical specialties, as well as transitional year interns) were recruited for the study.

• Participating subjects had less than five total live intubations.

• Training was provided by faculty otolaryngologists and anesthesiologists using both the Macintosh laryngoscopes, as well as the video-assisted laryngoscopes on a manikin airway simulator (Laerdal Medical, Wappingers Falls, NY, USA) in a normal intubating scenario (Cormack-Lehane Grade I).

• Subjects were then randomized into one of two testing groups—Macintosh laryngoscope or video-assisted laryngoscope in a difficult intubation scenario for a single attempt at intubation (Figure 1).

Figure 1: Protocol Flow Diagram

Methods

Successful Intubation

• The Macintosh laryngoscope group (n=19) had an intubation success rate of 52.63%.

• The video-assisted laryngoscope group (n=21) demonstrated a significantly higher rate of success (100%, p=0.0001) (Figure 3).

• Clinically meaningful improvement to warrant the increased cost and reduced risk to patient, as well as a smaller group of personnel.

• Based on a power of 0.8 at the 0.05 level, 19 subjects were required per study arm.

• Categorical data regarding success or failure of intubation were compared between study arms using Fisher’s Exact test.

• Time to intubation and confidence in ability to intubate VAS scores were compared using a one way analysis of variance.

Discussion

Difficult intubation scenarios may present for both experienced and inexperienced physicians in the hospital and prehospital settings. This has further significance for military and governmental agency medical providers who may encounter similar scenarios abroad in combat environments, and in transit across the Pacific and Atlantic Ocean in areas with limited contingency options. Video-assisted laryngoscopy gives the intubating provider, irrespective of experience, an airway for patients despite a poor view (Cormack-Lehane Grade III in our manikin scenario).

The intubation success rates for the direct laryngoscopy group (52.63%) and video-assisted laryngoscopy group (100%) are congruent with previous studies of personnel of varying levels of experience in live and simulated intubation scenarios.1,4 Testing by Nourizad-Steph, et al took heterogeneous groups of interns, nurses, medical students, and a paramedic with extensive laryngoscopy training but minimal live intubation experience and had overall live intubation success rates of 51% for direct laryngoscopy vs. 93% for the GlideScope® (100%) in an unembalmed or mildly obstructed view (Cormack-Lehane Grade I or II). In addition, Liu, et al utilized medical students to compare other video-assisted laryngoscopes, the Airtraq® Laryngoscope (Prodol Medical, Seattle, Washington, USA) and Ambu® Airway Scope (Pentax Medical, Montvale, New Jersey, USA) to direct laryngoscopy in a variety of different manikin scenarios (normal and three discrete difficult scenarios—cervical spine rigidity, limited oral cavity opening, and pharyngeal obstruction) to show improvement in intubation success using the Airway Scope (100%) and Airtraq® (83%) when compared to direct laryngoscopy (89%; p<0.05). The aforementioned video-assisted laryngoscopes differ from the GlideScope® both in the angle of the distal tip of their respective laryngoscopes, as well as having the endotracheal tube pre-loaded prior to intubation and parallel to the laryngoscope for increased ease of intubation. Our study differs from the previous literature by taking a larger, homogeneous group of inexperienced personnel (ie. 40 first year residents) with testing in a single, difficult intubation scenario via a combination of oral cavity, pharyngeal obstruction by way of tongue edema, as well as a rigid cervical spine immobility which caused restriction of neck extension and oral cavity opening. This was done purposely to mimic a possible real-world scenario, as well mitigate any potential improved performance throughout the course of testing, which is typically how previous studies were conducted in which all participants would participate using both laryngoscopes in the normal and difficult scenarios in a randomized order.

Video-assisted laryngoscopy demonstrates shorter intubation times for a difficult intubation simulation in our study. Our groups for video-assisted and direct laryngoscopy had mean intubation times of 69.0 and 23.1 seconds, respectively (p=0.0001). This parallels our intubation success results and is also consistent with the intubation times of previous studies testing inexperienced personnel.

Limitations of the simulation included inability to create pharyngeal wall edema, supraglottic soft tissue edema, as well as laryngospasm. Further soft tissue injury as a result of the laryngoscope itself with either the laryngoscope or endotracheal tube with stylet, as well as venous or sanguinous secretions which may be present and significantly impede view were not simulated.

Conclusion

This study demonstrates that physicians with little to no prior intubation experience showed significantly higher intubation success with lower intubation times using a video assisted laryngoscope in this difficult airway simulation model.

References


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Figure 2: Traditional Versus Video-Assisted Laryngoscopy Visual Analog Scale

Figure 3: Successful Intubation (Percentage)

Figure 4: Intubation Time (Seconds)