Advances in Medical Education and Practice

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

A review of the literature: direct and video laryngoscopy with simulation as educational intervention

This article was published in the following Dove Press journal:
Advances in Medical Education and Practice
28 January 2014
Number of times this article has been viewed

Allison A Vanderbilt[1]
Julie Mayglothling[1]
Nicholas J Pastis[2]
Douglas Franzen[3]

[1]School of Medicine, Virginia Commonwealth University, Richmond, VA, [2]Division of Pulmonary and Critical Care, Medical University of South Carolina, SC, [3]School of Medicine, University of Washington, WA, USA

Correspondence: Allison A Vanderbilt
School of Medicine, Virginia Commonwealth University, 730 East Broad St Suite 4200 Box 980466, Richmond, VA 23298, USA
Tel +1 804 827 8490
Fax +1 804 827 0663
Email avanderbilt@vcu.edu

Introduction: A review of the literature was conducted to analyze the impact of simulation-based training for direct and video laryngoscopy (VL) skills for health care professionals and health care students.

Methods: This review focused on the published literature that used randomized controlled trials to examine the effectiveness of simulation-based training to develop airway management skills and identify pertinent literature by searching PubMed from inception of the database up to July 2013. This current review addresses the question of whether airway management simulation-based training improves the acquisition of resuscitation skills for health care profession learners.

Results: A total of eleven articles qualified for this systematic review based on the inclusion and exclusion criteria. These studies were analyzed and the specific simulators, participants, assessments, and details related to: time of intubation; Cormack and Lehane classification; success and failure rate; and number of attempts.

Conclusion: This review suggests that simulation-based training is one effective way to teach VL skills. VL allows for a higher success rate, faster response time, and a decrease in the number of attempts by health care students and health care professionals under the conditions based on the eleven studies reviewed.

Keywords: laryngoscopy, video laryngoscopy, simulation, systematic review, health care professionals, health care students

Introduction

More than 400,000 Americans die annually from sudden cardiac arrest.[1] Sudden cardiac death is a serious medical problem[2] and it is critical that there is a rapid response because it influences survival outcomes for the patient; each additional minute of delayed defibrillation will reduce survival in cardiac arrest by 7%–10%. Airway management is a fundamental skill set for health care professionals. It is reported that annually in Canada 100 to 700 real life events for airway management lead to cannot intubate or cannot ventilate situations.[3] Scientific evidence for the treatment of cardiac arrest focuses on medical expertise, chest compressions, early defibrillation, and hyperventilation avoidance.[4,5]

Unfortunately, a significant proportion of deaths from injury are considered preventable[6] due to the lack of airway management support. According to Batchelder et al, many of these injuries are from failure to identify and treat life-threatening injuries promptly in the pre-hospital phase of care.[7] The National Confidential Enquiry into Patient Outcomes and Death concluded that the current structure of pre-hospital management is insufficient to meet the needs of the severely injured patient and that

submit your manuscript | www.dovepress.com
Dovepress
http://dx.doi.org/10.2147/AMEP.S51963

the pre-hospital response should include someone with the skill to rescue the airway and maintain adequate ventilation.[8] Inadequate airway management for endotracheal intubation in a pre-hospital setting is the primary cause of preventable mortality.[9] There continues to be adverse outcomes related to mismanagement of cannot intubate and cannot ventilate situations, such as death and brain damage.[10–12]

Simulation-based education has been implemented in many training sub specialties such as anesthesia, emergency medicine, and surgery[13] and with medical students.[14] Although simulations have been effective in training programs, the rigor and quality of research in the field still needs improvement.[13] Simulation can assist with the analysis of medical knowledge and other factors that influence the delivery of adequate care in cardiopulmonary arrest.[15]

Direct laryngoscopy (DL) is a difficult skill to master[16] and requires multiple exposures and attempts to acquire the skills necessary to replicate DL successfully on a patient. Narang et al[17] argue the unanticipated difficult airway can be risky for the patient; thus requiring great training on behalf of the physician. However, video laryngoscopy (VL) has shown improvement with glottis exposure compared to DL[18] and VL has been developed to manage difficult airways.[19] The purpose of this manuscript is to review the literature and compare DL with VL using simulation as an education intervention.

Methods

We focused on the published literature that examined the effectiveness of DL and VL with simulation-based training as the educational intervention. Studies were identified by searching PubMed, from the inception of the database to July 2013. Multiple combinations of several relevant medical subject headings (MeSH) terms were used to identify articles for review (laryngoscopy, laryngoscopy and simulation; video laryngoscopy, laryngoscopy and simulation). This resulted in a total of 1,152 published manuscripts to review. The inclusion and exclusion criteria address how these manuscripts were eliminated for our search to eleven.

Inclusion and exclusion criteria

Inclusion criteria required that studies: a) use a randomized controlled design; b) single-group pretest-posttest; c) two group nonrandomized; d) parallel group; e) crossover designs; and f) used simulation-based training as the educational intervention. Simulation-based training was defined broadly to range from task trainers to high fidelity simulators. The exclusion criteria were: a) opinion or commentary literature; b) not a study; and c) studies that did not use simulation as the educational intervention.

Data extraction and analysis

Two authors read the literature and independently determined if the article should be included in the review based on the previously stated inclusion criteria. When reviewing the literature, some abstracts provided enough detail and information related to the methods to determine if the inclusion criteria were met; if not, the full manuscript was then read to determine if the methods met the inclusion criteria. The manuscripts in which the methods did not meet the inclusion criteria were excluded. The two reviewers met to discuss the included and excluded manuscripts. All differences with respect to inclusion of a study were resolved with unanimity as the final criterion.

Results

A total of eleven articles were identified for this review based on the inclusion and exclusion criteria to compare DL and VL. These studies were analyzed and the specific simulators and/or task trainers, participants, assessments, and details of the eleven studies are provided in both Tables 1 and 2.

The average amount of time the participants received on training with the VL was 7.6 minutes (ranging from 1–12 minutes, standard deviation [SD] =4.51). In two studies the participants did not practice (n=2),[20,22] whereas, two studies allowed the participants to practice a simulated VL until they felt competent.[24,25] Following the training of the participants with simulation and VL they were given an assessment. These assessments include the following: two studies in the emergency department (18%), one study with the patient on the floor (9%), one study in the ambulance stations and emergency departments (9%), one study in a simulation lab (9%), one study at a major trauma scene (9%), and five studies whose location was not specified (45%). Finally, three studies (27%) used automated data collected from the simulator for their outcome data. The majority of the studies used observational ratings (82%) and participant self-report (55%) as the source for assessment.

Time of intubation

Time of intubation (n=8) was reported as the amount of time to perform a successful intubation. Of the eight studies (38%) that assessed whether time of intubation increased when using VL, three reported statistically significant improvement in time to intubate. For instance, one study described the median time to intubation as 25 seconds

Table 1 Study participants, simulation, features of training procedures, and assessment

Citation	Participants	Simulation intervention	Laryngoscope blade	Training time	Intubation scenarios
Aziz et al[20]	• 25 novice paramedic students	• SimMan®	• Macintosh 3 • MVL with Mac3	• No practice	• Mac3/normal neck • Mac3/stiff neck • Mac3 + MVL/normal neck • Mac3 + MVL/stiff neck
Bair et al[18]	• 39 emergency medicine residents and attending physicians	• AirMan®	• Macintosh	• Unstructured	• Normal airway with direct laryngoscopy • Difficult airway simulation (maximal cervical spine stiffness and trismus), with direct laryngoscopy • Same difficult airway simulation managed with video laryngoscopy
Butchart et al[21]	• 30 paramedics	• Nakhosteen Bronchoscopy model scopin'	• GlideScope® Ranger (GSR) • Venner AP Advance (APA)	• 1 minute per technique	• Direct laryngoscopy • GSR • APA
Donoghue et al[22]	• 26 pediatric emergency physicians	• SimNewB® • SimBaby® • AirMan®	• Miller 0 • Miller 1	• No practice	• Three intubations with video display turned on • Three intubations without video display turned on
Fonte et al[23]	• 16 pediatric residents	• SimBaby®	• GlideScope	• 10 minutes	• Easy airway (normal airway) • Tongue edema • Tongue edema and oropharyngeal edema • Cervical collar with normal airway
Hodd et al[24]	• 90 clinicians	• Laerdal airway Management trainer • SimMan 3G®	• Macintosh 3 • GlideScope Ranger • AP Advance	• Until the participant believed themselves competent with each technique	• Normal airway • Difficult airway
Lim et al[19]	• 20 anesthetists	• Human patient simulator	• Macintosh • GlideScope	• Not specified*	• The GlideScope in easy/difficult laryngoscopies • The Macintosh in easy/difficult laryngoscopies
Legrand et al[25]	• 60 anesthetists	• SimMan®	• Bullard • Airtraq • Macintosh-type	• 12 minutes	• Scenario A: neck immobilisation using a hard cervical collar and a long spine board • Scenario B: identical baseline conditions as in scenario A with additional tongue oedema
Narang et al[17]	• 52 emergency medicine residents and attending physicians	• SimMan®	• Macintosh	• 10 minutes	• Standard – routine, uncomplicated intubations • Difficult – decreased neck mobility • Difficult – tongue edema
Sylvia et al[26]	• 69 pediatric and emergency medicine residents	• SimBaby®	• Miller • Macintosh • GlideScope portable GVL	• Until the participant felt comfortable with the techniques	• Direct laryngoscope • Video laryngoscope
Wetsch et al[27]	• 25 anesthetists	• Ambu® Airway Man	• GlideScope Ranger • Storz C-MAC® • Ambu-Pentaz AWS • Airtraq • McGrath series 5 video	• 5 minutes	• Video laryngoscope • Macintosh laryngoscope

Note: *Articles that are unclear or do not supply an explanation of information.
Abbreviations: APA, AP advance; GSR, GlideScope Ranger; MVL, Macintosh Video Laryngoscope.

Table 2 Published reference, context of final assessment, source of assessment, skills assessed post-training, and results from studies

Citation	Contextual settings for assessment	Source of assessment ratings	Skills assessed post training	Results
Aziz et al[20]	• Normal neck on stretcher • Stiffened neck on floor	• Endpoint was recorded by student • Recorded observations	1. Intubation time 2. POGO 3. Success rate 4. Number of attempts 5. Satisfaction of MVL	• The MVL significantly improved POGO in all scenarios ($P<0.05$) • The MVL improved mean POGO 16%±6% in the manikin with a normal neck position on a stretcher and 33%±7% in the manikin with a stiff neck on the floor • The improvement was significantly greater in simulated difficult scenarios • The intubation success rate (94%) was equal in the two groups, and the POGO was significantly worse in the failures
Bair et al[18]	Emergency department	• Single investigator recorded grade I/II Cormack–Lehane direct and videos views	1. Ease of intubation 2. Time to intubation 3. Number of attempts	• On difficult laryngoscopy, a Cormack–Lehane grade I or II view was obtained in 20 (51%) direct laryngoscopies versus 38 (97%) of the video-assisted laryngoscopies ($P<0.01$) • The median VAS score for difficult airways was 50 mm (IQR =28–73 mm) for direct versus 18 mm (IQR =9–50 mm) for video ($P<0.01$) • The median time to intubation in difficult airways was 25 seconds (IQR =16–44 seconds) for direct versus 20 seconds (IQR =12–35 seconds) for video laryngoscopy ($P<0.01$) • All intubations were successful without need for an invasive airway
Butchart et al[21]	Ambulance stations and emergency departments	• An investigator by direct visualization under chest plate for time • An investigator counting the number of additional discrete forward advances of the ETT • VAS completed by the participant	1. Time to secure tracheal intubation 2. Evaluation of potential trauma 3. Number of attempts	• Time to achieve optimal view between AP Advance (APA) and GlideScope® Ranger (GSR) was not different (20 seconds versus 19 seconds; $P=0.19$), but tracheal intubation was significantly faster with the APA (25 seconds versus 46 seconds; $P<0.0001$) • Intubation success was 97% in both groups • Participants judged subjective trauma to be less for the APA than GSR on a visual analog scale (VAS; 1.6 cm versus 3.3 cm; $P<0.001$) • More than three forward advances were required in 43% of GSR and 0% of APA intubations
Donoghue et al[22]	Tertiary care pediatric hospital simulation lab	• Study subject reported POGO score	1. First attempt success 2. POGO score	• In the adult simulator, videolaryngoscopy use showed a first-attempt success in 81% of subjects compared with 39% with direct laryngoscopy (difference 43%; 95% CI 18% to 67%) • There was no difference in first-attempt success rates between videolaryngoscopy and direct laryngoscopy in the newborn or infant simulators • Videolaryngoscopy use led to increased POGO scores in all three simulators, with a difference of 25% (95% CI 2% to 48%) in newborn simulators, 23% (95% CI 2% to 48%) in infant simulators, and 42% (95% CI 18% to 66%) in adult simulators

Table 2 (*Continued*)

Fonte et al[23]	Not specified*	• Two investigators present during sessions • SimBaby® video recordings • Participants subjective impression	1. Rate of successful placement of endotracheal tube 2. Duration of the tracheal incubation procedure 3. Number of attempts 4. Number of optimization maneuvers required 5. Severity of upper jaw trauma	• Failed intubations were higher with GlideScope in normal airway and tongue edema scenarios (3 versus 0, in both cases) • Mean (SD) time to successful intubation was significantly longer with GlideScope in the normal airway scenario (GlideScope, 38 [SD, 13] versus Miller, 26 [SD, 16] seconds; $P=0.043$) • The number of maneuvers was significantly higher with GlideScope in the tongue edema and oropharyngeal edema scenario (2.3 [SD, 1.5] versus 1.5 [SD, 1]; $P=0.04$) • Upper jaw injury index was significantly lower with GlideScope in normal airway (2.0 [SD, 1] versus 2.6 [SD, 0.8]; $P=0.008$) and cervical collar (2.1 [SD, 1.0] versus 2.8 [SD, 0.5]; $P=0.011$) scenarios • Participants considered GlideScope technique more difficult than standard Miller in NA (5 [SD, 2.0] versus 3 [SD, 1.3]; $P=0.04$) and TE (5.9 [SD, 2.5] versus 3.9 [SD, 1.7]; $P=0.02$) scenarios
Hodd et al[24]	Not specified*	• Participant-declared (time to successful intubation, with censoring of failed intubations)	1. Time 2. Intubation failures 3. Potential damage to laryngoscopy structure 4. Device rating	• APA and Macintosh were virtually identical in normal airways (median, 22 versus 23 seconds) • Intubation with the APA was faster than with the GlideScope in difficult airways (hazard ratio =7.6 [5.0, 11.3], $P<0.001$; median, 20 versus 59 seconds) • All participants intubated the difficult airway mannequin with the APA, whereas 33% and 37% failed with the GlideScope and Macintosh, respectively • In the difficult airway, 99% of participants achieved a Cormack and Lehane grade I to II view with the APA, versus 85% and 33% with the GlideScope and Macintosh, respectively • When asked to choose one device overall, 82% chose the APA
Lim et al[19]	Not specified*	• Blinded investigator	1. Successful or failed intubation 2. Time to intubate 3. Ease of intubation 4. Graded (1–3) by the anesthetist 5. Choice of intubating device	• In the easy scenarios, the anesthetists took longer to intubate using the GlideScope than the Macintosh laryngoscope (mean (SD) 19.0 (9.7) seconds versus 12.7 (5.9) seconds, respectively; $P=0.006$) • There was no difference in the number of successful intubations, ease of intubation, or choice of intubating device • In the difficult scenarios, the anesthetists took less time to intubate using the GlideScope (23.5 (12.7) seconds versus 70.5 (101.2) seconds, respectively; $P=0.001$) • The slightly higher success rate with the GlideScope was not statistically significant (20/20 versus 18/20, respectively; $P=0.5$) • The anesthetists found it easier to intubate using the GlideScope (median (interquartile range [range]) 1 (1–2 [1–2]) vs 2 (2–3 [1–3]), respectively; $P<0.0001$)

(*Continued*)

Citation	Contextual settings for assessment	Source of assessment ratings	Skills assessed post training	Results
Legrand et al[25]	Not specified*	• Verification by one of the investigators using the lung inflation monitoring of the SimMan® • Matlab 7.1 for dental stress • Self-report of device usefulness	1. Intubation success rate 2. Time 3. Amount of dental stress 4. Satisfaction with airway device	• In Scenario A (neck immobilization), intubation success rates were 97%–100% with all devices • In Scenario B (neck immobilization with tongue edema), all participants failed to intubate the trachea using the conventional laryngoscope • When using the Bullard laryngoscope, intubation success rates of 87%–97% did not differ significantly ($P>0.05$) from those during scenario A and between groups (beginners versus experts) • When using the Airtraq laryngoscope, the overall intubation success rate was significantly lower ($P<0.05$) compared with scenario A and compared with use of the Bullard laryngoscope, and differed between beginners and experts (20 and 50%, respectively) • Intubation times were longer during scenario B • Dental stress was always lower ($P<0.05$) during use of the Bullard and Airtraq laryngoscopes compared with the conventional laryngoscope, lowest ($P<0.05$) during use of the Bullard laryngoscope
Narang et al[17]	Not specified*	• Co-investigators • CL classification (grades I–IV)	1. Time to view vocal cords 2. Time to intubate for success or failure	• Participants successfully intubated the mannequin faster using the Macintosh blade in both the normal and neck immobility settings (9.4 seconds faster, 95% CI 3.2–15.7, $P=0.004$, 16.1 seconds faster, 95% CI 3.6–28.7, $P=0.01$) • In the tongue edema setting, video laryngoscopy provided a better grade view of the cords, a higher success rate of viewing the cords at time of intubation (50% versus 12%), and a higher rate of successful intubations (83% versus 23%) • The GlideScope significantly reduced the time needed to view the cords (89 seconds reduction, 95% CI 54.4–123.7, $P<0.0001$) and intubate (131.3 seconds reduction, 95% CI 99.1–163.6, $P<0.0001$) for the tongue edema setting
Sylvia et al[26]	Emergency department	• Ventilation volume was recorded by SimBaby® • Investigators reviewed video sessions	1. Time to complete entire scenario 2. Announce need for intubation 3. Achieve intubation	• Seven subjects in the DL group required multiple attempts (21%), compared with 6 subjects in the VL group (17%) ($P=0.718$) • Median time to intubation was 30 seconds (95% confidence interval [CI], 19Y41 seconds) for DL and 39 seconds (95% CI, 36Y42 seconds) for VL ($P=0.111$) • Comparison of programs revealed a 77% PED success rate versus 85% EM success rate ($P=0.578$) and median time to intubation of 38 seconds (95% CI, 31Y45 seconds) for PED compared with 32 seconds (95% CI, 23Y41 seconds) for EM residents ($P=0.316$)

Wetsch et al[27]	Typical out-of-hospital setting, major trauma scene	• One member of the investigation team • Cormack and Lehane classification by participants	1. Time to achieve view of the glottis 2. Time of tracheal intubation 3. Time to cuff inflation 4. Time of first ventilation 5. Tracheal tube position	• Subjects successful at first attempt revealed a 13-second median difference (DL, 23 seconds [95% CI, 18Y28 seconds] vs VL, 36 seconds [95% CI, 29Y43 seconds; P=0.01) • Glottic view, tracheal intubation, cuff inflation and first ventilation were achieved most rapidly with the Macintosh laryngoscope, although the Airtraq and Pentax AWS video laryngoscopes were not significantly slower • Times were significantly longer when the GlideScope Ranger, McGrath series 5 or Storz C-MAC® video laryngoscopes were used (P<0.05), failure to place the endotracheal tube correctly was significantly commoner with the McGrath series 5 than with the Macintosh (P=0.031)

Notes: *Articles that are unclear or do not supply an explanation of information.
Abbreviations: APA, AP advance; CI, confidence interval; CL, Cormack–Lehane; DL, direct laryngoscopy; EM, emergency department; ETT, emergency trauma technician; GSR, GlideScope Ranger; IQR, interquartile range; MVL, Macintosh Video Laryngoscope; NA, normal airway; PED, pediatrics; POGO, percentage of glottic opening; SD, standard deviation; TE, tongue edema; VAS, visual analog scale; VL, video laryngoscopy.

(interquartile range [IQR]=16–44 seconds) using DL and 20 seconds (IQR =12–35 seconds) for VL (P<0.01).[18] In another study, the anesthetists took less time to intubate, in the difficult scenarios, when using the GlideScope than the Macintosh laryngoscope 23.5 (12.7) seconds versus 70.5 (101.2) seconds, respectively (P=0.001).[19] Another study reported that intubation with the AP Advance was faster than with the GlideScope in difficult airways (median, 20 versus 59 seconds, P<0.001).[24] On the other hand, four studies reported VL taking longer to intubate than DL.[17,23,26,27] One study, did not explicitly report their significant or non-significant findings.[20]

Cormack and Lehane classification

The Cormack–Lehane (CL; n=4) grading system is used to assess and quantify the laryngoscopic view of the vocal cords and glottis. The complete exposure of the glottis, or the best view, is defined as CL grade I whereas, in CL grade IV, neither the glottis nor epiglottis can be seen. In three of the four studies (75%), researchers reported that the VL provided a better grade view. For example, one study found that during a difficult laryngoscopy, a CL grade of I or II view was obtained in only 20 (51%) DL versus 38 (97%) of the video-assisted laryngoscopies (P<0.01).[18] In addition, the VL provided a better grade view of the cords and significantly reduced the time needed to view the cords (89 second reduction; P<0.0001) in another study.[17] Similarly, another study found that in the difficult airway scenario, 99% of the participants achieved a CL grade I to II view with the AP Advance VL, versus 85% and 33% with the GlideScope and Macintosh, respectively.[24] In the last study, the glottic view was achieved most rapidly with the Macintosh laryngoscope, although it was not significantly faster than the VL.[27]

Success and failure rate

Seven of the eleven studies evaluated the rate of successful or failed intubations. Automated data or an investigator assessed a successful intubation as the tube being passed through the vocal cords in the mannequin. Thus, a failed intubation is the tube not passing through the vocal cords to allow an open airway. One of the seven studies (14%) reported a statistically significant increase in success rate while using the VL. During the difficult scenario in this study, all participants failed to intubate the trachea using the conventional laryngoscope. The same study examined two different VL devices in addition to the conventional method. While using the Bullard laryngoscope, the success rate was significantly higher (P<0.05) than when the participants used the Airtraq laryngoscope.[25]

Two of the seven studies (29%) found an increase in failure rates and a decrease in success rates while using the VL. Fonte et al reported higher failed intubations with the GlideScope in normal airway and tongue edema scenarios (3 versus 0, in both cases).[23] In another study, there was a 13-second median difference during the first successful attempt (DL, 23 seconds versus VL 36 seconds, P=0.01).[26] The majority of the studies (57%) did not find significant differences in intubation success rates in DL and VL procedures.[18–21]

Number of attempts

Three of the eleven total studies (27%) reported on the number of attempts to successfully intubate. All three studies (100%) found a decrease in the number of attempts to intubate while using a VL. More specifically, the VL used during the adult simulation showed a first-attempt success in 81% of subjects compared with 39% with DL (a difference of 43%).[22] In a different study, more than three forward advances were required in 43% of GlideScope Ranger and 0% of the AP Advance VL intubations.[21] Although not statistically significant, Sylvia et al had seven subjects in the DL group require multiple attempts (21%) compared with the six subjects in the VL group (17%; P=0.718).[26]

Discussion

This review of laryngoscopy research adds evidence that simulation-based training can result in skill transfer, providing a safe and effective way for health care professionals to practice and for health care students to learn. Additionally, it is evident based on the review of the literature that students learn faster, have fewer errors, and require fewer attempts when using a VL. VL has the potential to replace the traditional DL as an educational tool with simulation; however, additional research is needed. Potentially in the future, VL may replace DL in all settings, but the authors would caution against not teaching DL. DL is still an important skill to know and have should there be a potential natural disaster or crisis when DL is the only skill available.

Future research needs to focus on a larger sample size, maintenance of skills, and patient outcomes. In order to determine that VL may be a better method of accessing the throat, vocal cords, and airway it is essential that data be collected on patient outcomes.

Limitations

As with any systematic review, our review and results are limited by the data provided in the original studies. Thus, despite the adequate number of relevant studies, the studies included in this systematic review provide only a limited basis for examining the impact of simulation in laryngoscopy skills training. Our findings are also limited by the lack of descriptions of the data collection process and interventions of the included studies. The lack of effect size reporting contributes to the difficulty in truly understanding the magnitude of the effect of these interventions on the acquisition of laryngoscopy skills.

The scope of our review is both a strength and limitation. However, it is not possible to draw firm conclusions about the effectiveness of the different types of simulation based on this review. Nonetheless, we argue that our review does provide useful insight into the literature that examines the effectiveness of simulation-based laryngoscopy training interventions. The need for more robust examinations of these training interventions is needed to be able to provide an unequivocal conclusion to the impact on learning, maintenance of skills, and potentially better outcomes for patients.

Conclusion

This review suggests that simulation-based training is one effective way to teach VL laryngoscopy skills. VL allows for a higher success rate, faster response time, and a decrease in the number of attempts by health care students and health care professionals under the conditions based on the eleven studies reviewed. The findings from this initial review of the literature VL have the potential to be a more effective way to view a patient's throat, vocal cords, and airway.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Rubart M, Zipes DP. Mechanisms of sudden cardiac death. *J Clin Invest*. 2005;115(9):2305–2315.
2. Demaria S, Bryson EO, Mooney TJ, et al. Adding emotional stressors to training in simulated cardiopulmonary arrest enhances participant performance. *Med Educ*. 2010;44(10):1006–1015.
3. Crosby E. The unanticipated difficult airway – evolving strategies for successful salvage. *Can J Anaesth*. 2005;52(6):562–567.
4. Aufderheide TP, Lurie KG. Death by hyperventilation: a common and life-threatening problem during cardiopulmonary resuscitation. *Crit Care Med*. 2004;32(Suppl 9):S345–S351.
5. Eftestøl T, Wik L, Sunde K, Steen PA. Effects of cardiopulmonary resuscitation on predictors of ventricular fibrillation defibrillation success during out-of-hospital cardiac arrest. *Circulation*. 2004;110(1): 10–15.
6. Royal College of Surgeons of England and British Orthopaedic Association. *Better Care for the Severely Injured*. London: Royal College of Surgeons of England; 2000.
7. Batchelder AJ, Steel A, Mackenzie R, Hormis AP, Daniels TS, Holding N. Simulation as a tool to improve the safety of pre-hospital anaesthesia – a pilot study. *Anaesthesia*. 2009;64(9):978–983.
8. Henning DC, Smith JE, Patch D, Lambert AW. A comparison of civilian (National Confidential Enquiry into Patient Outcome and Death) trauma standards with current practice in a deployed field hospital in Afghanistan. *Emerg Med J*. 2011;28(4):310–312.

9. Adnet F, Lapostolle F, Ricard-Hibon A, Carli P, Goldstein P. Intubating trauma patients before reaching hospital – revisited. *Crit Care*. 2001;5(6):290–291.
10. Cheney FW, Posner KL, Lee LA, Caplan RA, Domino KB. Trends in anesthesia-related death and brain damage: A closed claims analysis. *Anesthesiology*. 2006;105(6):1081–1086.
11. Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Management of the difficult airway: a closed claims analysis. *Anesthesiology*. 2005;103(1):33–39.
12. Berkow LC, Greenberg RS, Kan KH, et al. Need for emergency surgical airway reduced by a comprehensive difficult airway program. *Anesth Analg*. 2009;109(6):1860–1869.
13. Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach*. 2005;27(1):10–28.
14. Pastis NJ, Doelken P, Vanderbilt AA, Walker J, Schaefer JJ. Validation of simulated difficult bag-mask ventilation as a training and evaluation method for first-year internal medicine house staff. *Simul Healthc*. 2013;8(1):20–24.
15. Gaba DM, DeAnda A. A comprehensive anesthesia simulation environment: re-creating the operating room for research and training. *Anesthesiology*. 1988;69(3):387–394.
16. Mulcaster JT, Mills J, Hung OR, et al. Laryngoscopic intubation: learning and performance. *Anesthesiology*. 2003;98(1):23–27.
17. Narang AT, Oldeg PF, Medzon R, Mahmood AR, Spector JA, Robinett DA. Comparison of intubation success of video laryngoscopy versus direct laryngoscopy in the difficult airway using high-fidelity simulation. *Simul Healthc*. 2009;4(3):160–165.
18. Bair AE, Olmsted K, Brown CA, Barker T, Pallin D, Walls RM. Assessment of the storz video Macintosh laryngoscope for use in difficult airways: A human simulator study. *Acad Emerg Med*. 2010;17(10): 1134–1137.
19. Lim TJ, Lim Y, Liu EH. Evaluation of ease of intubation with the GlideScope or Macintosh laryngoscope by anaesthetists in simulated easy and difficult laryngoscopy. *Anaesthesia*. 2005;60(2): 180–183.
20. Aziz M, Dillman D, Kirsch JR, Brambrink A. Video laryngoscopy with the macintosh video laryngoscope in simulated prehospital scenarios by paramedic students. *Prehosp Emerg Care*. 2009;13(2): 251–255.
21. Butchart AG, Tjen C, Garg A, Young P. Paramedic laryngoscopy in the simulated difficult airway: comparison of the Venner AP Advance and GlideScope Ranger video laryngoscopes. *Acad Emerg Med*. 2011;18(7):692–698.
22. Donoghue AJ, Ades AM, Nishisaki A, Deutsch ES. Videolaryngoscopy versus direct laryngoscopy in simulated pediatric intubation. *Ann Emerg Med*. 2013;61(3):271–277.
23. Fonte M, Oulego-Erroz I, Nadkarni L, Sánchez-Santos L, Iglesias-Vásquez A, Rodríguez-Núñez A. A randomized comparison of the GlideScope videolaryngoscope to the standard laryngoscopy for intubation by pediatric residents in simulated easy and difficult infant airway scenarios. *Pediatr Emerg Care*. 2011;27(5):398–402.
24. Hodd JA, Doyle DJ, Gupta S, et al. A mannequin study of intubation with the AP advance and GlideScope Ranger videolaryngoscopes and the Macintosh laryngoscope. *Anesth Analg*. 2011;113(4):791–800.
25. Legrand MA, Steinmann D, Priebe HJ, Mols G. Comparison of Bullard and Airtraq laryngoscopes with conventional laryngoscopy in a manikin study of simulated difficult intubation. *Eur J Anaesthesiol*. 2012;29(7):343–350.
26. Sylvia MJ, Maranda L, Harris KL, Thompson J, Walsh BM. Comparison of success rates using video laryngoscopy versus direct laryngoscopy by residents during a simulated pediatric emergency. *Simul Healthc*. 2013;8(3):155–161.
27. Wetsch WA, Carlitscheck M, Spelten O, et al. Success rates and endotracheal tube insertion times of experienced emergency physicians using five video laryngoscopes: a randomised trial in a simulated trapped car accident victim. *Eur J Anaesthesiol*. 2011;28(12):849–858.