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REPORTS OF ORIGINAL INVESTIGATIONS

Video-laryngoscopy *versus* direct laryngoscopy in critically ill patients: a pilot randomized trial

Étude pilote randomisée comparant la vidéo-laryngoscopie et la laryngoscopie directe chez les patients gravement malades

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Abstract

Purpose *Endotracheal intubation in critically ill patients is associated with a high risk of complications that tend to increase with multiple attempts at laryngoscopy. In this pilot study, we compared direct laryngoscopy (DL) with video-laryngoscopy (VL) with regard to the number of attempts and other clinical parameters during endotracheal intubation of critically ill patients performed by novice providers.*

Methods *Patients were randomized to either VL or DL for endotracheal intubation. Exclusion criteria for the study included: requirement for immediate endotracheal intubation, cervical spine precautions, anticipated difficult intubation, oxygen saturation < 90%, or systolic blood pressure < 80 mmHg despite resuscitation. The providers, predominantly non-anesthesiology residents in their first three years of postgraduate training, received a one-hour teaching and mannequin session prior to performing the procedures.*

Results *Forty patients, mean age 65 (standard deviation, 16) yr were randomized to VL (n = 20) or DL (n = 20). Sixty percent of the patients received endotracheal intubation for respiratory failure, and all patients received a neuromuscular blocker. Multiple attempts were required in 25/40 (63%) patients, and this did not differ with technique (P = 1.0) Video-laryngoscopy resulted in improved glottic visualization with 85% of patients having a Cormack-Lehane grade 1 view compared with 30% of patients in the DL group (P < 0.001). Total time-to-intubation for VL was 221 sec*

Donald Griesdale was the principle investigator and responsible for the concept and design of the study. He had access to all of the data and takes full responsibility for the integrity of the data and the accuracy of the data analysis. *Anton Chau, George Isac, Denise Foster, Corrie Irwin,* and *Peter Choi* were involved in the design of the study. *Denise Foster* was involved in data acquisition, and *Anton Chau, George Isac, Najib Ayas, Denise Foster,* and *Peter Choi* were involved in interpretation of the data. *Donald Griesdale, Anton Chau, George Isac, Najib Ayas, Denise Foster, Corrie Irwin,* and *Peter Choi* helped draft the manuscript. *Anton Chau, George Isac, Najib Ayas, Denise Foster,* and *Corrie Irwin* critically revised the manuscript. *Peter Choi* was involved in interpretation of the data, and he also revised the manuscript prior to submission.

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(interquartile range [IQR 103-291]) vs 156 sec [IQR 67-220] for DL (P = 0.15). Video-laryngoscopy resulted in a lower median SaO_2 (86%) during endotracheal intubation [IQR 75-93] compared with a median SaO_2 of 95% in the DL group [IQR 85-99] (P = 0.04).

Conclusions *Video-laryngoscopy resulted in improved glottic visualization compared with DL; however, this did not translate into improved clinical outcomes. The trial was registered on ClinicalTrials.gov number, NCT00911755.*

Résumé

Objectif *L'intubation endotrachéale chez des patients gravement malades est associée à un risque élevé de complications qui tendent à être plus nombreuses après de multiples tentatives de laryngoscopie. Dans cette étude pilote, nous avons comparé la laryngoscopie directe (DL) et la vidéo-laryngoscopie (VL) pour ce qui concerne le nombre de tentatives et d'autres paramètres cliniques au cours de l'intubation endotrachéale de patients gravement malades réalisée par des praticiens novices.*

Méthodes *Les patients ont été randomisés dans un groupe d'intubation endotrachéale par VL ou par DL. Les critères d'exclusion de l'étude étaient les suivants : nécessité d'une intubation endotrachéale immédiate, précautions à prendre pour la colonne cervicale, difficultés attendues pour l'intubation, saturation en oxygène < 90 %, ou pression artérielle systolique < 80 mmHg malgré la réanimation. Les praticiens – essentiellement des résidents autres que des résidents en anesthésiologie, effectuant leurs trois premières années de formation postdoctorale, ont reçu un enseignement d'une heure et une session de formation sur mannequin avant de réaliser les procédures.*

Résultats *Quarante patients, d'âge moyen 65 ans (écart type 16 ans) ont été randomisés dans le groupe VL (n = 20) ou DL (n = 20). Soixante pour cent des patients ont eu une intubation endotrachéale pour insuffisance respiratoire et tous les patients ont reçu un curare. Des tentatives multiples ont été nécessaires chez 25 patients sur 40 (63 %) et cette proportion n'a pas été différente selon la technique (P = 1,0). La vidéo-laryngoscopie a entraîné une meilleure visualisation de la glotte, 85 % des patients ayant un score de Cormack-Lehane de grade I, comparativement à 30 % des patients dans le groupe DL (P < 0,001). Le temps total d'intubation pour la VL a été de 221 secondes (plage interquartile [IQR 103-291]) contre 156 secondes [IQR 67-220] pour la DL (P = 0,15). La vidéo-laryngoscopie a entraîné une SaO_2 médiane (86 %) plus basse au cours de l'intubation trachéale [IQR 75-93], comparativement à une SaO_2 médiane de 95 % dans le groupe DL [IQR 85-99] (P = 0,04).*

Conclusions *La vidéo-laryngoscopie a procuré une meilleure visualisation de la glotte comparée à la DL. Toutefois, cela ne s'est pas traduit par une amélioration des résultats cliniques. L'étude a été enregistrée sur le site ClinicalTrials.gov sous le numéro NCT00911755.*

In contrast to the elective operating room setting, complications are common in critically ill patients during the time of endotracheal intubation. Severe hypoxemia and hypotension occur in up to 26% and 30% of patients, respectively.[1] Although the limited physiological reserve of these patients predisposes them to higher complication rates,[2] the variability in the expertise of physicians who provide airway management in the intensive care unit (ICU) also plays a role.[3] In particular, multiple attempts at endotracheal intubation, which have been associated with an increased risk of severe complications,[1] occur more frequently with non-anesthesiology residents than with their anesthesiology counterparts.[3] Even in skilled hands, severe complications occur in up to 28% of patients.[4] Furthermore, difficult tracheal intubation and laryngoscopy are more frequent in critically ill patients, complicating 6.6-22% and 11-12% of intubations, respectively.[1,4-6] Technologies that can improve glottic visualization and improve the success of intubation may help reduce complications during emergency endotracheal intubation.

The Glidescope® video-laryngoscope (Verathon Medical, Bothell WA, USA) is an indirect rigid fibreoptic laryngoscope that incorporates a video camera toward the end of an angled blade. Video-laryngoscopy (VL) has consistently shown improved glottic visualization compared with direct laryngoscopy (DL), particularly in patients with anticipated or simulated difficult DL.[7] Furthermore, compared with DL, VL has also been shown to increase the success of intubation performed by novice personnel in the elective operative setting.[8,9] Given this information, we hypothesized that inexperienced providers would achieve a better rate of success on their first attempts at tracheal intubation in critically ill patients by using the Glidescope VL rather than by performing DL. The goal of this pilot study was to generate point estimates for a larger randomized controlled trial (RCT) comparing VL with DL in critically ill patients. Our secondary goals were to compare VL with DL on a variety of surrogate markers, such as Cormack-Lehane glottic view, time-to-intubation (successful first attempt and total time required), and complications.

Methods

This manuscript is an account of our pilot RCT in accordance with the CONsolidated Standards Of Reporting Trials (CONSORT) statement.[10] The Clinical Research Ethics Board at the University of British Columbia and the Vancouver Coastal Health Authority approved the study

protocol and waived the requirement for written informed consent.

Study design

We conducted a parallel-arm RCT to compare the first attempt at endotracheal intubation using DL *vs* using a Glidescope VL. The procedures were performed by inexperienced providers in adult patients requiring an urgent endotracheal intubation by the critical care team. The intensive care unit (ICU) at Vancouver General Hospital is a 27-bed "closed" medical-surgical unit that operates with a nurse-to-patient ratio of approximately 1:1.2.

Inclusion criteria were patients older than 16 yr requiring endotracheal intubation by the critical care team. Patients were excluded if they required immediate endotracheal intubation (within five minutes) as anticipated by the ICU team, a spontaneous breathing endotracheal intubation technique, or cervical spine precautions. Additional exclusion criteria included a history of (or anticipated) difficult intubation; previous cardiac arrest or cardiopulmonary instability (oxygen saturation [SaO_2] $< 90\%$ or systolic blood pressure [SBP] < 80 mmHg despite oxygen or fluid and vasopressor therapy); prior clinical deterioration requiring immediate tracheal intubation while awaiting randomization; or deemed inappropriate for enrolment by the attending physician (e.g., patient considered unsuitable for either technique).

Operators (medical students or non-anesthesiology residents) were eligible to participate in the study if they were inexperienced in endotracheal intubation, defined as less than five endotracheal intubations in the preceding six months. At the beginning of their rotation, all primary operators received a one-hour didactic and practical session by either an ICU attending or a fellow physician comfortable with both techniques (having performed at least 25 intubations with each method). To be included in the study, the operators had to intubate the trachea of an airway mannequin successfully with both DL and Glidescope VL. All study intubations were supervised by either a critical care fellow or an attending intensivist.

The allocation sequence was generated by the principal investigator using a random allocation table in permuted blocks of four. Patient allocation was contained in numbered opaque sealed envelopes that were opened by the research coordinator at the time of randomization. Neither the intubating physician nor the research coordinators were blinded to the intervention. All patients were preoxygenated with 100% oxygen for three minutes, and cricoid pressure was applied at the discretion of the supervising physician. To standardize intubating conditions between groups, all patients received a neuromuscular blocking agent as part of their induction. A train-of-four stimulator was not used. The tracheas of patients allocated to DL were intubated with a Macintosh laryngoscope with either #3 or #4 blades. Patients allocated to VL were intubated with the Glidescope VL with a size-4 GVL® blade. A stylet was used in the endotracheal tube for all intubations. The supervisor could take over the laryngoscopy at any time, especially if the operator's initial attempt exceeded one minute or the patient decompensated (e.g., $SaO_2 < 80\%$, SBP < 70 mmHg). Successful endotracheal intubation was confirmed by auscultation and the presence of end-tidal carbon dioxide on capnography.

Data collection and outcome variables

The research coordinator collected baseline demographic and clinical characteristics, including the Acute Physiology and Chronic Health Evaluation (APACHE) II score.[11] During endotracheal intubation, the study coordinator completed a standardized data collection form that included the following details for each intubation attempt: duration, operator, technique (VL or DL or other), vital signs (lowest SaO_2, lowest SBP), and Cormack-Lehane glottic view.[12] We defined the start of the intubation attempt as the moment when the tip of the laryngoscope entered the patient's mouth. Repositioning or suctioning while maintaining the laryngoscope in position was counted as a single attempt. The end of a successful endotracheal intubation was defined as detection of an end-tidal carbon dioxide waveform on capnography. The total time to successful intubation was documented regardless of the number of attempts.

Statistical analysis

Since this was a pilot study, we did not calculate a formal sample size. We used the intention-to-treat principle for all data analyses. We described categorical data with proportions and percentages, normally distributed continuous data with means and standard deviations (SD), and non-normally distributed data with medians and interquartile ranges (IQR). We used Fisher's exact test for bivariate comparisons of categorical data, independent Student's t test for comparisons of continuous data, and the Wilcoxon rank-sum test for comparisons of non-normally distributed data (time required for endotracheal intubation and duration of ICU / hospitalization). All tests were two-sided; a P value < 0.05 was considered statistically significant. All analyses were performed using Stata® 10.0 (StataCorp LP, College Station, TX, USA).

Results

From August 9, 2009 to January 14, 2011, we randomly allocated 40 patients requiring urgent endotracheal

intubation to VL ($n = 20$) and DL ($n = 20$) without any loss to follow-up. Patient flow is presented in the Figure.

Baseline patient and operator characteristics were similar between the two groups (Table 1). Overall, the patients' mean age was 65 (SD 16) yr and 28 (70%) were male. The mean APACHE II score was 21 (SD 6). The main indication for endotracheal intubation was respiratory failure ($n = 24$, 60%), and the tracheas of 33 (83%) patients were intubated in the ICU. The majority of patients were classified as Mallampati 1 or 2 on inspection of the oropharynx; however, data were missing in 16 (40%) patients. The primary operators were predominantly internal medicine residents ($n = 24$, 60%) in their first three years of postgraduate training (PGY-1, $n = 11$, 28%; PGY-2, $n = 14$, 35%; PGY-3, $n = 11$, 28%). Two medical students acted as primary operators, both in the VL group. All endotracheal intubations were supervised by either a critical care medicine fellow ($n = 17$, 43%) or staff ($n = 23$, 57%).

Drugs used around the time of intubation are presented in Table 2. Vasopressors were infused prior to tracheal intubation in 7 (18%) patients, and ketamine was used for induction in 34 (85%) patients, with a mean dose of 66 (SD 25) mg. All patients received a neuromuscular blocking agent, either succinylcholine ($n = 24$, 60%) or rocuronium ($n = 16$, 40%), as part of their induction.

Outcomes are presented in Table 3. The tracheas of all patients were successfully intubated, and there were no deaths during endotracheal intubation. Glottic visualization was better in the VL group with 17 (85%) patients having a Cormack-Lehane grade 1 view compared with 6 (30%) patients randomized to DL ($P < 0.001$). The number of intubation attempts was the same for both groups. Multiple endotracheal intubation attempts were required in 12 (60%) patients in the VL group and 13 (65%) patients in the DL group. In the VL group, five of 12 (42%) first attempts with VL failed and resulted in the use of DL for subsequent attempts. In contrast, only one of 13 (5%) first attempts failed with DL and resulted in the use of VL for subsequent attempts ($P = 0.03$). The supervisor took over in eight of 12 (67%) failed first attempts with DL (with data missing from one patient) compared with four of the 12 (33%) in the VL group ($P = 0.22$). The median time required for a successful endotracheal intubation (total time, regardless of number of attempts) did not differ between the two techniques (VL 221 sec; IQR [103-291] *vs* DL 156 sec; IQR [67-220]; $P = 0.15$).

Mean arterial pressure did not differ between the two techniques at baseline, during intubation, or five minutes following endotracheal intubation. At baseline, oxygenation did not differ between the two groups (median partial pressure of oxygen [PaO_2] 91 mmHg; IQR [72-108] in the VL group *vs* PaO_2 81 mmHg; IQR [63-127] in the DL group; $P = 0.40$). However, during endotracheal intubation, the lowest median SaO_2 was lower in the VL group than in the DL group (86%; IQR [75-93] *vs* 95%; IQR [85-99], respectively; $P = 0.04$). This difference did not persist five minutes after endotracheal intubation.

Mortality in the ICU (8/40, 20%) and in the hospital (13/40, 33%) did not differ between the two groups. Duration

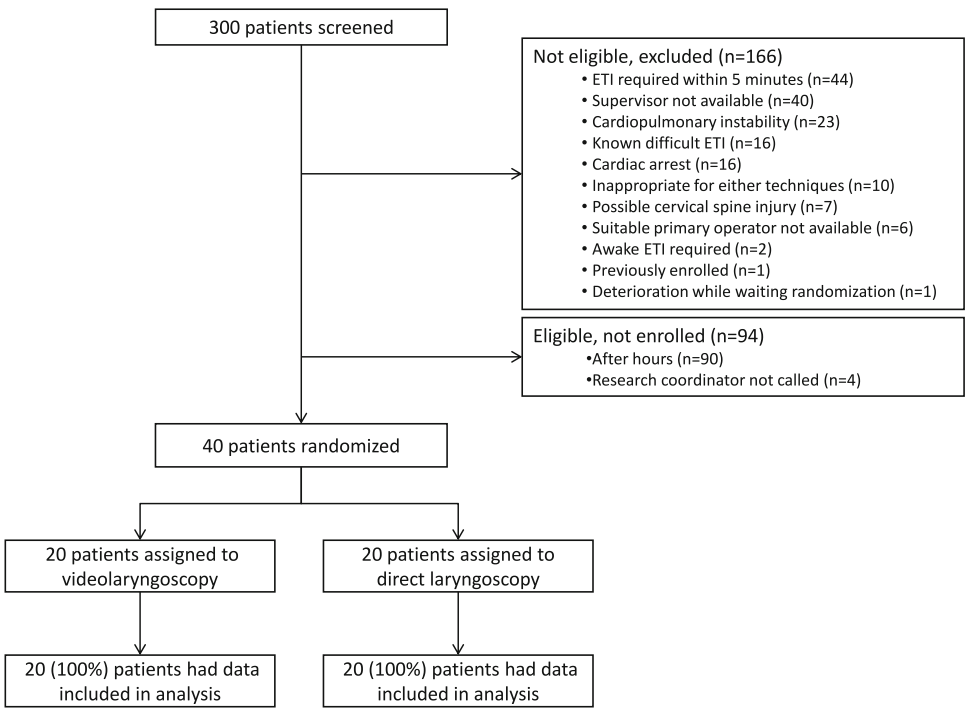

Figure Patient enrolment, exclusion, randomization, and follow-up assessment for the trial

of intubation, ICU length of stay, and hospitalization were comparable between groups.

Discussion

In this single-centre pilot RCT comparing VL to DL for intubation performed by novice airway operators in critically ill patients, results showed improved glottic visualization using VL. This result did not translate into increased success during the first intubation attempt or decreased time-to-intubation. Furthermore, patients randomized to VL had a lower SaO_2 during tracheal intubation than patients randomized to DL.

The improved glottic visualization afforded by VL is a consistent finding in the literature[7,13] and has been shown even in the hands of novice providers in the controlled setting of the operating room.[8,9] In contrast to these previous studies, our study was performed in the less controlled environment of the ICU were intubations are unplanned. Although our trial was not designed to detect a difference in clinical outcomes, the improved glottic visualization afforded by VL did not translate into clinically relevant outcomes. A recent meta-analysis showed increased success in the first intubation attempt and faster time-to-intubation when comparing use of the Glidescope with DL in studies of novice providers.[7] These results should be interpreted with caution, however, as there were only two studies in this subgroup.[8,9] In the study by Nouruzi-Sedeh *et al.* comparing VL with DL in elective surgical patients, the novice providers received considerably more intensive mannequin training than in our study.[8] In addition to didactic training, the subjects had to perform three successful tracheal intubations in the mannequin with each technique within a 60-sec limit for each attempt. Perhaps our results reflect a lack of adequate training; thus, it is not surprising that intensity of training is a crucial component in developing competence.

We unexpectedly showed decreased SaO_2 during endotracheal intubation in patients allocated to VL. Although not statistically different, endotracheal intubation using VL did require 18 more sec in patients whose tracheas were successfully intubated on first attempt. This time difference possibly explains the difference in SaO_2 observed between the two groups. Patients who are critically ill with respiratory failure often derive minimal, if any, benefit from preoxygenation prior to endotracheal intubation.[2] Hence, an additional 18 sec could certainly result in a marked decrease in SaO_2 in this high-risk patient population. There may be several explanations for the increased time required for endotracheal intubation with VL compared with DL. When the supervisor can observe the patient's airway on the monitor during VL, it is more likely that the primary operator will be allowed to spend more time on the attempt. In contrast, the supervisor often cannot visualize the airway during DL and, therefore, may have a lower waiting threshold before taking over the intubation attempt from the primary operator. The technique of inserting the Glidescope blade may be another reason for the longer time-to-intubation. After the glottic view is obtained, the endotracheal tube must then be brought to, and inserted through, the glottis. This can

Table 1 Patient and operator characteristics

	Video-laryngoscope (n = 20)	Direct laryngoscope (n = 20)
Patient characteristics		
Mean age (SD)	68 (16)	61 (16)
Male, *n* (%)	15 (75)	13 (65)
Mean BMI (SD)	26 (4)	24 (6)
Mean APACHE II score (SD)	19 (4)	23 (7)
Indication for intubation, n (%)		
Respiratory failure	14 (70)	10 (50)
Decreased level of consciousness	3 (15)	5 (25)
Shock	2 (10)	1 (5)
Procedure	0	3 (15)
Airway obstruction	0	1 (5)
Secretions	1 (5)	0
Mallampati class		
1/2/3/4	5/6/2/1	3/4/3/0
Not tested, *n* (%)	6 (30)	10 (50)
Location of intubation, n (%)		
Intensive care unit	19 (95)	14 (70)
Ward	1 (5)	3 (15)
Emergency department	0	3 (15)
Operator characteristics		
Operator year of training, *n* (%)		
Medical student	0	2 (10)
PGY-1	4 (20)	7 (35)
PGY-2	7 (35)	7 (35)
PGY-3	7 (35)	4 (20)
PGY-4	1 (5)	0
Missing	1 (5)	0
Operator specialty, n (%)		
Internal medicine	12 (60)	12 (60)
Surgery	6 (30)	5 (25)
Medical student	0	2 (10)
Family practice	0	1 (5)
Missing	2 (10)	0

SD = standard deviation; BMI = body mass index; APACHE = Acute Physiology and Chronic Health Evaluation; PGY = postgraduate year

Table 2 Medications administered comparing video-laryngoscopy with direct laryngoscopy

	Video-laryngoscope (n = 20)	Direct Laryngoscope (n = 20)
Ketamine use, n (%)	16 (80)	18 (90)
Ketamine dose (mg), mean (SD)	64 (20)	67 (29)
Propofol use, n (%)	3 (15)	3 (15)
Propofol dose (mg), mean (SD)	80 (35)	70 (30)
Midazolam use, n (%)	12 (60)	12 (60)
Midazolam dose (mg), mean (SD)	2.5 (1.3)	2.5 (0.89)
Fentanyl use, n (%)	13 (65)	4 (20)
Fentanyl dose (μg), mean (SD)	86 (58)	100 (41)
Rocuronium use, n (%)	8 (40)	8 (40)
Rocuronium dose (mg), mean (SD)	53 (7)	54 (11)
Succinylcholine use, n (%)	12 (60)	12 (60)
Succinylcholine dose (mg), mean (SD)	98 (36)	106 (22)
Vasopressors		
Norepinephrine use prior to ETI n (%)	2 (10)	3 (15)
Dopamine use prior to ETI, n (%)	1 (5)	1 (5)
Phenylephrine use during ETI, n (%)	4 (20)	4 (20)
Phenylephrine dose during ETI (μg), median [IQR]	150 [100-400]	100 [75-150]

SD = standard deviation; ETI = endotracheal intubation; IQR = interquartile range

be a challenge due to 1) the hand-eye coordination required to bring the endotracheal tube to the glottis and 2) the acute anterior angle of the endotracheal tube in relation to the tracheal axis, which complicates passage through the glottis.[14] Although these two limitations become minimized with experience, they may be exacerbated in novice operators.

There are several limitations to our study. First, we encountered difficulties with patient accrual. To allow time for randomization and to ensure patient safety for laryngoscopy by a novice operator, patients had to be relatively stable from a cardiopulmonary perspective. Excluding patients with marked hemodynamic instability not only impaired patient accrual but also limited external validity. Including expert operators would increase the ease of subject enrolment and the external validity of a study. It remains to be seen whether inclusion of expert operators would result in increased success in endotracheal intubation with the VL compared with DL. In a recent meta-analysis performed by our group, success in the first attempt at endotracheal intubation was not increased by expert providers using the Glidescope.[7] The majority of studies have reported a > 90% rate of success on first attempt by expert providers using DL.[15-18] Thus, it seems unlikely that VL would improve first attempt success by expert operators in patients without difficult laryngoscopy. A recent observational study by Aziz *et al.* showed that the Glidescope was more likely to be used by anesthesiologists in patients who had predictors of difficult laryngoscopy.[19] Successful tracheal intubations occurred in 96% of these patients using the Glidescope, and it was able to rescue failed DL in 94% of patients. Overall, it appears that the VL is being used in patients with predictors of difficult DL and in those where DL failed.[19] Even so, in critically ill patients who have a higher rate of difficult laryngoscopy compared with elective surgical patients, second- and third-year anesthesiology residents were successful on the first attempt at endotracheal intubation in 85% of cases.[3] Given the expert providers' high rate of success on first attempt, it seems unlikely that a single technique would show superiority in unselected patients.

Another question raised by this trial is the role that novice operators should play in airway management. Limited access to anesthesiologists and/or critical care physicians in many centres necessitates airway management by physicians from various specialty backgrounds. For example, rapid sequence intubation has become the purview of emergency physicians who generally perform this procedure with a high degree of skill and success.[20,21] The objectives of training in internal medicine by the Royal College of Physicians and Surgeons of Canada list endotracheal intubation as a procedural skill under cardiopulmonary resuscitation.[22] Indeed, the 2010 American Heart Association Guidelines for Adult Advanced Cardiovascular Life Support (ACLS) states "…ideally ACLS providers also should be trained and experienced in insertion of an advanced airway."[23] Although immediate availability of expert providers of endotracheal intubation is ideal, interventions that enhance airway management skills in novice providers should be studied and incorporated. A final limitation to our study is the intubating physician's lack of blinding to the intervention, an inherent limitation in this type of study design. We attempted to minimize this bias by having trained observers with objective clinical secondary outcomes.

In conclusion, in our single-centre pilot RCT comparing VL with DL, VL showed improved glottic visualization, but this did not translate to an increase in successful intubations on first attempt. In its current form, the results of this study do not support a larger efficacious randomized trial of video-laryngoscopy *vs* direct laryngoscopy performed by novice providers in critically ill patients.

Table 3 Outcomes comparing video-laryngoscopy with direct laryngoscopy

	Video-laryngoscope (n = 20)	Direct Laryngoscope (n = 20)	P value
Number of attempts, n (%)			1.0
1	8 (40)	7 (35)	
2	9 (45)	11 (55)	
3	2 (10)	2 (10)	
4	1 (5)	0	
Time for successful intubation (min), median [IQR]	221 [103-291]	156 [67-220]	0.15
Time for successful intubation at first attempt (min), median [IQR]	79 [63-119]	61 [40-67]	0.20
Cormack-Lehane grade on first attempt, n (%)			< 0.001
1	17 (85)	6 (30)	
2	0	8 (40)	
3	0	4 (20)	
4	2 (10)	1 (5)	
Cricoid pressure applied, n (%)	8 (40)	14 (70)	0.11
Technique for second attempt, n (%)			0.03
Glidescope®	7 (58)	1 (5)	
Direct laryngoscope	5 (42)	11 (90)	
Missing		1 (5)	
Hemodynamics			
Baseline MAP (mmHg), mean (SD)	88 (18)	84 (23)	0.54
Lowest MAP during first attempt (mmHg), mean (SD)	81 (28)	77 (29)	0.93
MAP at 5 min post intubation (mmHg), mean (SD)	85 (13)	78 (19)	0.23
Oxygenation			
Baseline PaO_2 (mmHg), median [IQR]	91 [72-108]	81 [63-127]	0.40
Baseline SaO_2, % median [IQR]	98 [95-100]	99 [96-100]	0.45
Lowest SaO_2 during first attempt, % median [IQR]	86 [75-93]	95 [85-99]	0.04
SaO_2 5 min post intubation, % median [IQR]	97 [95-100]	99 [97-100]	0.09
PaO_2 post intubation (mmHg), median [IQR]	115 [92-175]	138 [80-192]	0.86
Hospital length of stay (days), median [IQR]	36 [16-51]	36 [15-76]	0.85
ICU length of stay (days), median [IQR]	10 [6-16]	6 [3-14]	0.30
Duration of intubation (days), median [IQR]	3 [2-7]	3 [2-7]	0.56
Tracheostomy, n (%)	5 (25)	1 (5)	0.18
ICU mortality, n (%)	3 (15)	5 (25)	0.70
Hospital mortality, n (%)	6 (30)	7 (35)	1.0

IQR = interquartile range; MAP = mean arterial pressure; SD = standard deviation; ICU = intensive care unit

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