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Clinical paper

Comparison of video laryngoscopy versus direct laryngoscopy for intubation in emergency department patients with cardiac arrest: A multicentre study

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Abstract

Aim: To compare the tracheal intubation performance between video laryngoscopy (VL) and direct laryngoscopy (DL) in patients with cardiac arrest in the ED.

Methods: This is an analysis of the data from a prospective, multicentre study of 15 EDs in Japan. We included consecutive adult patients with cardiac arrest who underwent intubation with VL or DL from 2012 through 2016. The primary outcome was first-attempt success. The secondary outcomes were glottic visualisation assessed with Cormack grade (1 vs. 2–4) and occurrence of oesophageal intubation. To examine the between-device difference in outcome risks, we analysed the whole data and 1:1 propensity score matched data.

Results: Among 9694 patients who underwent intubation in the EDs, 3360 cardiac arrests (35%) were included in the analysis (90% were non-traumatic cardiac arrests). The first-attempt success rate was higher in the VL group compared to those in the DL (78% vs 70%; unadjusted OR 1.61 [95%CI 1.26–2.06] $P < 0.001$). This association remained significant after adjusting for six potential confounders and within-ED clustering (adjusted OR 1.33 [95%CI 1.03–1.73] $P = 0.03$). VL use was also associated with a better glottic visualisation (adjusted OR 3.84 [95%CI 2.81–5.26] $P < 0.001$) and lower rate of oesophageal intubation (adjusted OR 0.45 [95%CI 0.24–0.85] $P = 0.01$) compared to DL. These results were consistent in the propensity score matched analysis.

Conclusions: Based on large multicentre prospective data of ED patients with cardiac arrest, the use of VL was associated with a higher first-attempt success rate compared to DL, with a better glottic visualisation and lower oesophageal intubation rate.

Keywords: Video laryngoscopy, Direct laryngoscopy, Resuscitation, Airway management, Emergency department

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Introduction

Tracheal intubation is a core component of cardiopulmonary resuscitation (CPR) to secure and protect the patient's airway. Recent studies have underscored the importance of successful intubation at the first attempt to minimise the interruption of chest compression and to avoid multiple intubation attempts that would lead to decreased success rates of rescue intubations,[1] increased risks of adverse events,[2,3] and poorer resuscitation outcomes.[2,4–7]

To improve the performance of airway management, video laryngoscopy (VL) has been increasingly chosen as the first device for intubation instead of conventional direct laryngoscopy (DL).[8–10] The superiority of VL over DL for a successful first attempt has been demonstrated in multiple settings, including the operating room,[11,12] intensive care unit[13,14] and emergency department (ED).[15,16] Furthermore, simulation-based studies on cardiac arrests also indicated an advantage of VL over DL.[17–19] While these findings suggest that the use of VL may achieve higher intubation success in ED patients with cardiac arrest, the limited literature about the use of VL in this patient population appears conflicting. Indeed, two single-centre studies ($n \leq 140$) from Korea reported the first-intubation success rate by VL to be no different from[20] or higher than[21] that by DL. Despite the clinical and research importance, the effectiveness of intubation performance between VL and DL in ED patients with cardiac arrest remains to be elucidated.

To address the knowledge gap in the literature, we aimed to investigate whether the use of VL is associated with a higher success rate at first intubation attempt compared to DL in ED patients with cardiac arrest by using the data from a large, multicentre, prospective study of emergency airway management.

Methods

Study design and settings

This is an analysis of the data from the second Japanese Emergency Airway Network study (JEAN-2 study) – a multicentre, prospective, observational study of 15 EDs in Japan.[1,2,8,22–24] Details of the study are described elsewhere.[24] In brief, the JEAN-2 study started enrolment of consecutive patients who underwent emergency tracheal intubation (regardless of indication, including cardiac arrest) at one of the participating EDs from February 2012. JEAN is a consortium of 15 EDs from different geographic regions across Japan, including Level I ($n = 12$) and Level II ($n = 3$) equivalent trauma centres with a median ED census of 28,000 visits per year (range, 1000–66,000 visits). All EDs were staffed by attending emergency physicians and affiliated with an emergency medicine residency programmes. All intubations were performed by emergency medicine resident, attending emergency physician, other specialties (surgery, anaesthesia, and internal medicine), or transitional-year resident (postgraduate-years one and two) supervised by attending emergency physician. The choice of intubation devices (VL or DL) was at the discretion of the supervising attending physician in the ED. The institutional review board of each participating institution approved the study protocol, with waiver of informed consent before data collection.

Study participants

From the JEAN-2 participants, we selected all adult patients with cardiac arrest who underwent tracheal intubations in the EDs from February 2012 through November 2017. We excluded patients with non-cardiac arrest, children (aged <18 years), and those who underwent intubation using other intubation devices (e.g., fibreoptic scope) or adjunctive device (e.g., bougie).

Data collection and processing

After each intubation course, the operator completed a standardised data collection form,[8,23] which included the patient characteristics (age, sex, height, weight, and modified LEMON score) and the course of airway management (indication of intubation, devices of intubation, intubation success or failure at each attempt, specialty of the intubator, and airway-related adverse events). Intubation attempt was defined as an insertion of the laryngoscope blade into the mouth. Successful intubation was defined as successful placement of tracheal tube past the vocal cords, with confirmation via quantitative or colorimetric end-tidal carbon dioxide monitoring. Body mass index (BMI) was calculated using the estimated height and body weight at the ED visit according to prior study[25] as measuring the patient's exact height and weight was difficult in patients who require ED airway management. The BMI was treated as a categorical variable based on the National Institutes of Health and World Health Organization criteria: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30.0 kg/m^2).[26] The study also measured the modified LEMON score to predict the difficulty of laryngoscopy[23] in each patient before the intubation attempt. The patients with modified LEMON score of ≥1 were categorised as expected difficult laryngoscopy.[23] The indication of intubation was categorised as non-traumatic and traumatic cardiac arrest. The specialties of the intubator were categorised as transitional-year resident (postgraduate years one and two), emergency medicine resident, attending emergency physician, and other specialties (surgery, anaesthesia, and internal medicine).[25,27]

We regularly monitored the compliance of data form completion. If the data form had any missing data, the site investigator returned the data form to the operator for completion. If information on the form contained inconsistencies, the site investigator interviewed the operator for clarification. If an intubation was identified without a data form, the investigator interviewed the operator within two weeks to maximise the capture rate. Additionally, all data were reviewed by the Study Coordinating Centre, and site investigators were queried about missing data and discrepancies identified by manual data checks.

Primary exposure and outcomes

The primary exposure was the use of VL for tracheal intubation (C-MAC®, McGrath®, Airway Scope®, and GlideScope®) in comparison with the use of DL. The primary outcome was the first-attempt success rate. The secondary outcomes were the rate of good glottic visualisation defined as Cormack-Lehane grade 1 and the rate of oesophageal intubation (early or delayed recognition).[28]

Statistical analysis

First, we compared the patient characteristics and airway management course between the VL and DL groups, using the Mann–Whitney

U test or chi-square test as appropriate. Second, to determine the association of intubation devices and outcomes, we fit logistic regression models with generalised estimating equation (GEE) to account for patients clustering within the ED. In the multivariable models, we adjusted for age, sex, BMI, indication for intubation, difficulty of laryngoscopy (modified LEMON score), and specialty of the intubator. These covariates were selected based on *a priori* knowledge and clinical plausibility.[1,24,29,30] Third, to balance the patient characteristics between the VL and DL groups, we also performed one-to-one propensity score (PS) matched analysis. PS was calculated using a logistic regression model with GEE estimating the likelihood of choosing VL. The variables used in this PS model were age, sex, BMI, indication for intubation, difficulty of laryngoscopy, and specialty of the intubator. One-to-one matching was then conducted based on the PS with the nearest matching method.[31] After PS-matching, we examined the balance using the standardised mean differences between the groups. A standard difference of <10% was considered as well-balanced.[32] In the sensitivity analysis, we repeated the analyses with stratification by different type of VL, indication of intubation (non-traumatic vs. traumatic arrest), and the specialty of the intubator (transitional-year resident, emergency medicine resident, and others). All statistical analyses were performed using the R version 3.4.4. R package "*geepack*" was used to construct the logistic regression models with GEE and "*MatchIt*" was used for the PS matched analyses. A p-value of <0.05 was considered significant.

Results

Patient characteristics

Of 9694 patients who underwent intubation in the EDs during the study period, the JEAN-2 study captured data from 9408 intubations (capture rate, 97%). From these, we excluded 5768 patients with non-cardiac arrest, 94 children, 28 patients intubated with devices other than VL or DL, and 158 patients with missing data on the specialty of the intubator, leaving 3360 patients eligible for the current study (Online Fig. 1 in Supplementary material). Overall, the median age was 75 years (IQR, 63–83), 61% were male, and 90% had non-traumatic cardiac arrest. The first-attempt success rate was 71%, 51% had a Cormack–Lehane grade of 1, and 5% had oesophageal intubation.

Association of VL intubation with first-attempt success

Of 3360 patients, 613 patients (18%) underwent intubation with VL while 2747 patients (82%) underwent intubation with DL. The VL group were younger, and more likely to have traumatic cardiac arrest and to be intubated by an emergency medicine resident or attending physician compared with the DL group (all $P < 0.05$; Table 1).

The first-attempt success rate in the VL group was higher than that in the DL group (78% vs. 70%; $P < 0.001$; Table 1), with a corresponding unadjusted odds ratio of 1.61 (95%CI 1.26–2.06; $P < 0.001$; Fig. 1 and Online Table 1 in Supplementary material). This association remained significant after adjusting for potential confounders and clustering of patients within the EDs (adjusted OR 1.33 [95%CI 1.03–1.73] $P = 0.03$; Table 2). This finding was driven by the significant association between C-MAC use and high intubation success (80% vs. 70%; adjusted OR 1.80 [95%CI 1.32–2.46] $P < 0.001$) while all four VL types had a higher crude rate of first-attempt success (Online Tables 2 and 3 in Supplementary material). Likewise, the use of VL was significantly associated with a better glottic visualisation (Cormack–Lehane grade 1, 74% vs. 46%; adjusted OR 3.84 [95%CI 2.81–5.26]; $P < 0.001$) compared to DL. In contrast, the VL group had a significantly lower rate of oesophageal intubation (2% vs. 5%; adjusted OR 0.45 [95%CI 0.24–0.85]; $P = 0.01$).

PS matched analysis

In the PS matched analysis, 547 matched-pairs were successfully balanced between the VL and DL groups (Table 3). Consistent with the findings in the primary analysis, the VL group had a significantly higher first-attempt success rate (OR 1.35 [95%CI 1.02–1.78] $P = 0.03$; Fig. 1), better glottic visualisation (OR 3.59 [95%CI 2.79–4.63]; $P < 0.001$), and lower rate of oesophageal intubation (OR 0.41 [95%CI 0.18–0.95]; $P = 0.04$; Fig. 1).

Sensitivity analysis

In the stratified analysis with a limited statistical power, the use of VL was associated with a significantly higher first-attempt success rate in patients with non-traumatic cardiac arrest (adjusted OR 1.35 [95%CI 1.02–1.79]; $P = 0.04$) and non-significantly higher rate in patients with traumatic cardiac arrest (adjusted OR 1.29 [95%CI 0.72–2.33]; $P = 0.39$; Table 2). In the stratified analysis by intubator specialty, the association remained significant when the patient was intubated by a transitional-year resident (adjusted OR 1.60 [95%CI 1.06–2.41] $P = 0.02$; Table 2). Additionally, the use of VL was associated with a better glottic visualisation across all strata (all $P < 0.05$; Online Table 4 in Supplementary material) and lower rate of oesophageal intubation when the patient was intubated by transitional-year resident ($P = 0.02$; Online Table 5 in Supplementary material).

Discussion

Based on the data from a large, multicentre, prospective study of ED patients with cardiac arrest, intubation with VL was associated with a higher first-attempt success rate compared to that with DL. We also found that the use of VL was associated with a significantly better glottic visualisation and lower oesophageal intubation rate. These observations persisted in the analysis using PS-matching, supporting the causal inference between the use of VL and improved intubation outcomes. We also observed that, while VL use was associated with a better glottic visualisation across all intubator's levels, the significant association with a higher first-attempt success persisted only when the intubator was a less-experienced intubators (i.e., post-graduate years one and two residents). By contrast, in intubations by more experienced intubators, there was no significant difference between VL and DL.

The superiority of VL over DL has been shown in multiple clinical settings – e.g., the operating room,[11,12] intensive care unit,[13,14] and general ED[15,16] settings. However, there have been only two studies that have investigated the use of VL in ED patients with cardiac arrest–an important clinical scenario with distinct challenges, such as the glottis movement secondary to chest compression, unexpected intubation difficulty with limited information of the patient, time pressure, and limited resources in the ED.[20,21] A non-randomised (historically-controlled), single-centre study from South Korea ($n = 83$) showed that, among intubations performed by novice emergency

Table 1 – The characteristics of study participants and airway management course according to the intubation devices.

Variables	Overall (n = 3360)	VL group (n = 613)	DL group (n = 2747)	P value
Patient characteristics				
Age (yr), median (IQR)	75 (63–83)	72 (61–82)	76 (64–83)	<0.001
Male sex	2051 (61)	397 (65)	1654 (60)	0.04
Body mass index				0.54
Underweight (<18.5 kg/m^2)	548 (16)	90 (16)	458 (18)	–
Normal weight (18.5–24.9 kg/m^2)	1920 (57)	367 (64)	1553 (62)	–
Overweight (25.0–29.9 kg/m^2)	501 (15)	96 (17)	405 (16)	–
Obese (≥30.0 kg/m^2)	116 (4)	22 (4)	94 (4)	–
Anticipated difficult laryngoscopy				
≥1 modified LEMON score	1356 (40)	247 (40)	1109 (40)	0.99
Airway management course				
Indication of intubation				<0.001
Non-traumatic cardiac arrest	3016 (90)	351 (85)	2322 (91)	–
Trauma cardiac arrest	344 (10)	92 (15)	252 (9)	–
Specialty of the intubator				<0.001
Transitional-year resident[a]	1888 (56)	182 (30)	1706 (62)	–
Emergency medicine resident	752 (23)	273 (46)	479 (18)	–
Attending emergency physician	654 (20)	154 (27)	500 (19)	–
Other specialty[b]	66 (2)	4 (1)	62 (2)	–
ED type				<0.001
Level I equivalent trauma centre	3086 (92)	504 (82)	2582 (94)	–
Level II equivalent trauma centre	274 (8)	109 (18)	165 (6)	–
Success rate				
First-attempt success rate	2393 (71)	480 (78)	1913 (70)	<0.001
Second-attempt success rate	3051 (91)	575 (94)	2476 (91)	0.005
Third-attempt success rate	3249 (97)	599 (98)	2650 (97)	0.19
Visualisation				
Cormack–Lehane grade				<0.001
Grade 1	1682 (51)	427 (74)	1255 (46)	–
Grade 2	1167 (36)	128 (22)	1039 (38)	–
Grade 3	334 (10)	14 (2)	320 (12)	–
Grade 4	102 (3)	12 (2)	90 (3)	–
Adverse events				
All adverse events	302 (9)	26 (4)	276 (10)	<0.001
Oesophageal intubation	154 (5)	10 (2)	144 (5)	<0.001

Abbreviations: DL, direct laryngoscopy; ED, emergency department; IQR, interquartile range; VL, video laryngoscopy.
Data were expressed as number (%) unless otherwise indicated.
[a] Defined as postgraduate year 1 or 2.
[b] Defined as surgery, anaesthesia, or internal medicine.

physicians, the use of VL (GlideScope) was associated with a higher first-attempt success rate and shorter duration of interruption of the chest compression compared to DL use.[21] By contrast, another small study (n = 140) from the same hospital reported no significant differences in the rate of first-attempt success between VL (GlideScope) and DL when intubation was performed by an experienced intubator.[20] These apparent inconsistencies between these studies might be attributable to the differences in study design, intubator's level of training, and outcome event rates (which leads to the different statistical power), or any combination of these factors. In contrast, the validity of our data is buttressed by the use of a multicentre design with a large sample size many times larger than any other prior study on this topic, which enabled us to investigate the heterogeneity in the effectiveness of VL across different intubator levels – e.g., less-experienced intubators had a significant association of VL with favourable intubation performance, while experienced intubators did not have a higher first-attempt success rate. Our study corroborates the findings of earlier studies, and extends them by demonstrating the heterogeneous associations between VL use and intubation performance in the real-world setting of ED patients with cardiac arrest.

There are several potential mechanisms for the observed association between the use of VL and high first-attempt success rate. First, VL enables the operator to visualise the glottis and surrounding structures through a micro-video camera, which improves the glottic visualisation[13,33–37] and reduces the rate of oesophageal intubation by direct visualisation of the tracheal tube passage through the vocal cord.[34] Indeed, the current study also demonstrated that VL use was associated with a better glottic visualization – across all intubator's levels – and lower rate of oesophageal intubation. Second, the use of VL also enables supervising physicians to monitor the operator's glottic view through the VL monitor, provides real-time guidance, and enhances assistance (e.g., adjustment of cricoid pressure) during the process of intubation.[38] Third, some types of VL (e.g., C-MAC) can be used as a DL when the visualisation is interrupted by secretions, blood, and vomitus during the emergency tracheal intubation, allowing intubators to direct visualisation immediately after the recognition of hampered visualisation of the VL monitor.

Interestingly, the magnitude of between-group difference was larger in glottic visualisation than that in first-pass success rates.

Outcomes	Proportion n (%) VL group	DL group	OR (95%CI)	P value
Video laryngoscope vs. Direct laryngoscope				
First-attempt success				
Primary analysis (n=3,360)				
Unadjusted association	480/3,360 (78)	1,913/3,360 (70)	1.61 (1.26-2.06)	<0.001
Adjusted association*	-	-	1.33 (1.03-1.73)	0.03
Propenity score matched analysis† (n=1,094)	429/1,094 (78)	395/1,094 (72)	1.35 (1.02-1.78)	0.03
Good glottic visualisation‡				
Primary analysis (n=3,360)				
Unadjusted association	427/3,360 (74)	1,255/3,360 (46)	3.85 (2.83-5.25)	<0.001
Adjusted association*	-	-	3.84 (2.81-5.26)	<0.001
Propenity score matched analysis† (n=1,094)	401/1,094 (73)	271/1,094 (49)	3.59 (2.79-4.63)	<0.001
Oesophageal intubation				
Primary analysis (n=3,360)				
Unadjusted association	10/3,360 (2)	144/3,360 (5)	0.32 (0.17-0.62)	<0.001
Adjusted association*	-	-	0.45 (0.24-0.85)	0.01
Propenity score matched analysis† (n=1,094)	8/1,094 (2)	18/1,094 (3)	0.41 (0.18-0.95)	0.04

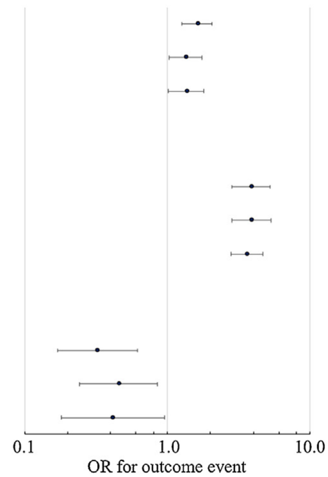

Fig. 1 – Associations between intubation devices and outcomes.
Abbreviations: DL, direct laryngoscopy; VL, video laryngoscopy.
The full result of the primary outcome models is summarised in Online Table 1.
***Logistic regression models with generalised estimating equation (GEE) adjusting for age, sex, body mass index, indication for intubation, difficult laryngoscopy score (modified LEMON score), and specialty of the intubator as well as accounting for within-ED clustering.**
†Propensity score (PS) was computed using logistic regression model with GEE to compute the likelihood of choosing VL. Variables used in PS matching were age, sex, body mass index, indication for intubation, difficult laryngoscopy score (modified LEMON score), and specialty of the intubator. One-to-one PS matching was performed by nearest matching method.
‡Defined as Cormack–Lehane grade 1.

The reasons remain to be elucidated. While Cormack–Lehane grade is a marker of glottic visualisation, there are other factors that contribute to tracheal tube placement such as the mechanics of laryngoscope and intubator's skills. For example, the use of DL, compared to a certain type of VL, may have allowed the intubator to better manipulate the tracheal tube regardless of glottic visualization. In addition, it is possible that the use of VL enabled less-experienced intubators to achieve a better visualization but they failed to intubate patients.

Sufficiently-powered, high-quality randomised controlled trials of airway management in ED patients with cardiac arrest would be helpful to further establish the causality of the observed association between VL use and better intubation performance. However, such trials are logistically difficult in this study population.[39] Further, the literature has demonstrated that subjects who were enrolled into a clinical trial framework might be systematically different from the general populations,[40] which limits the generalisability. Alternatively, our mulitcentre data with a high capture rate (97%) reflect the effectiveness of VL intubation in the natural setting of a real patient population and current practice, thereby enhancing the generalisability. We also note that multiple smaller studies arrived at similar conclusions[11,13,15] despite different study designs, settings, and populations. Furthermore, there are plausible mechanisms to support the findings. While there are ongoing controversies on the role on VL in critically-ill patients,[15,33,36,37] the findings of earlier studies and our data collectively lend a support to the use of VL as an optimal airway management strategy for ED patients with cardiac arrest.

Potential limitations

Our study has several potential limitations. First, as real-time independent monitoring of ED airway management in a multicentre setting is challenging to accomplish, the study relied on self-reported data. Nevertheless, we used a previously-applied standardised system with uniform definitions[24,29] to minimise its effect. Additionally, it is less likely that the choice of different intubation device (VL vs. DL) substantially changed the accuracy of self-reporting, and that this potential misclassification would not have biased our inferences. Second, as with any observational study, the causal inference may be confounded by unmeasured factors, such as the skill of individual intubators and between-hospital practice variations. However, we statistically accounted for patients clustering within the EDs. Third, our study focusing on intubation performance did not have the information on other outcomes, such as time required to perform intubation, duration of CPR interruption and in-hospital mortality. However, a previous study has shown the association between failed initial attempts and poorer patient outcomes (e.g., a decreased likelihood of return of spontaneous circulation [ROSC]) among patients with

Table 2 – Associations between intubation devices and first-attempt success rate.

	Unadjusted OR (95%CI)	P value	Adjusted OR[a] (95%CI)	P value
Overall				
Video laryngoscopy (vs. DL)	1.61 (1.26–2.06)	<0.001	1.33 (1.03–1.73)	0.03
Stratified analyses				
Indication of intubation				
Non-traumatic cardiac arrest				
Video laryngoscopy (vs. DL)	1.68 (1.29–2.20)	<0.001	1.35 (1.02–1.79)	0.04
Trauma cardiac arrest				
Video laryngoscopy (vs. DL)	1.52 (0.87–2.65)	0.14	1.29 (0.72–2.33)	0.39
Specialty of intubator				
Transitional-year resident[b]				
Video laryngoscopy (vs. DL)	1.54 (1.02–2.33)	0.04	1.60 (1.06–2.41)	0.02
Emergency medicine resident				
Video laryngoscopy (vs. DL)	0.97 (0.65–1.45)	0.89	0.98 (0.65–1.46)	0.91
Other physicians[c]				
Video laryngoscopy (vs. DL)	1.30 (0.76–2.22)	0.34	1.45 (0.85–2.50)	0.18

Abbreviations: DL, direct laryngoscopy; OR, odds ratio; CI, confidence interval.

[a] Logistic regression model with generalised estimating equation (GEE) adjusting for age, sex, body mass index, indication for intubation, difficult laryngoscopy score (modified LEMON score), and specialty of the intubator as well as accounting for within-ED clustering.

[b] Defined as postgraduate year 1 or 2.

[c] Defined as attending emergency physician, or other specialty.

Table 3 – Characteristics of the propensity score-matched groups (one-to-one matching).[a]

Variables	VL group (n = 547)	DL group (n = 547)	P value	SMD (%)
Patient characteristics				
Age (year), median (IQR)	72 (61–82)	74 (62–82)	0.47	3.3
Male sex	352 (64)	350 (64)	0.95	0.8
Body mass index			0.95	0.036
Underweight (<18.5 kg/m^2)	87 (16)	90 (17)	–	–
Normal weight (18.5–24.9 kg/m^2)	350 (64)	354 (65)	–	–
Overweight (25.0–29.9 kg/m^2)	91 (17)	84 (15)	–	–
Obese (≥30.0 kg/m^2)	19 (4)	19 (4)	–	–
Anticipated difficult laryngoscopy				
≥1 modified LEMON score	230 (42)	225 (41)	0.81	1.9
Airway management course				
Indication of intubation			0.99	0.005
Non-traumatic cardiac arrest	466 (85)	465 (85)	–	–
Trauma cardiac arrest	81 (15)	82 (15)	–	–
Specialty of the intubator			0.99	0.004
Transitional-year resident[b]	155 (28)	155 (28)	–	–
Emergency medicine resident	242 (44)	241 (44)	–	–
Attending emergency physician	147 (27)	148 (27)	–	–
Other specialty[c]	3 (1)	3 (1)	–	–
Success rate				
First-attempt success rate	429 (78)	395 (72)	0.02	–
Visualisation				
Good glottic visualisation[d]	401 (73)	271 (49)	<0.001	–
Adverse events				
Oesophageal intubation	8 (2)	18 (3)	0.07	–

Abbreviations: DL, direct laryngoscopy; VL, video laryngoscopy; SMD, standardised mean difference; IQR, interquartile range.

Data were expressed as number (%) unless otherwise indicated.

[a] Propensity score (PS) was computed using logistic regression model with generalised estimating equation to estimate the likelihood of choosing VL. Variables used in PS matching were age, sex, body mass index, indication for intubation, difficult laryngoscopy score (modified LEMON score), and specialty of the intubator. One-to-one PS matching was performed by nearest matching method.

[b] Defined as postgraduate year 1 or 2.

[c] Defined as surgery, anaesthesia, or internal medicine.

[d] Defined as Cormack–Lehane grade 1.

cardiac arrest,[7] which supports the importance of first-attempt success for patient outcomes. Lastly, as our study sample consisted of academic EDs in Japan, the inferences should be generalised cautiously to different healthcare systems (e.g., non-industrialised nations) and settings (e.g., prehospital setting).

Conclusions

By using the data from a multicentre prospective study of 3360 ED patients with cardiac arrest, we found that tracheal intubation with VL was significantly associated with a higher first-attempt success rate compared to that with DL. The association remained significant when the intubator was less-experienced. In contrast, there was no significant between-device difference in the success rate in more-experienced intubators, suggesting that the intubator's skills also play an important role in intubation success. We also found that the use of VL was associated with a significantly better glottic visualisation and lower oesophageal intubation rate. These observations persisted across different analytical assumptions. In conjunction with the earlier studies demonstrating the importance of first-attempt success in the ED, our study lends additional supports to the use of VL as the first device for intubation in ED patients with cardiac arrest in addition to the continued efforts to improve intubator's competence. Our data should also advance research into the development of optimal resuscitation strategy, which will, in turn, improve the outcomes of patients with cardiac arrest.

Conflicts of interest

None.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.resuscitation.2018.10.005.

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