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Hyper-angulated (Glidescope) versus intermediate-angled (UED-A) videolaryngoscopy for routine tracheal intubation in adults: a prospective randomized controlled trial

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Videolaryngoscopy (VL) has become the gold standard for airway management. However, performance differences among blade geometries—especially between hyper-angulated and intermediate-angled designs—remain underexplored in routine airway management. We conducted a prospective randomized controlled trial comparing a hyper-angulated videolaryngoscope (GlideScope) and a novel intermediate-angled device (UED-A) during elective tracheal intubation of sixty adult patients. Patients were randomized to either device, with total intubation time as the primary outcome. Secondary outcomes included first-pass success, time to glottic visualization, number of attempts, external manipulation, Cormack-Lehane grade, adverse events, and user satisfaction. All patients were successfully intubated. No statistically significant differences were observed between groups in total intubation time (UED-A: 30.9 ± 13.8 s vs. GlideScope: 29.5 ± 13.0 s; $p = 0.73$), time to glottic visualization (UED-A: 12.9 ± 4.7 s vs. GlideScope: 13.5 ± 5.4 s; $p = 0.74$), or first-pass success (UED-A: 93% vs. GlideScope: 97%; $p > 0.99$). Other secondary outcomes were also comparable between devices. In routine adult tracheal intubation, the intermediate-angled UED-A videolaryngoscope demonstrated a non-inferior performance to GlideScope, indicating that both devices offer similarly effective and user-friendly options for standard airway management. This suggests that intermediate-angled UED-A videolaryngoscope may serve as viable alternatives to hyper-angulated GlideScope in clinical practice. Registry: ClinicalTrials.gov, TRN: NCT05721690, Registration date: February 1, 2023.

Keywords Airway management, Hyper-angulated blade, Intermediate-angled blade, Randomized controlled trial, Tracheal intubation, Videolaryngoscopy

Tracheal intubation is a fundamental aspect of anesthetic practice, involving the insertion of a flexible tube through the mouth or nose into the trachea, essential to secure and maintain an open and protected airway in patients undergoing elective surgical procedures or emergency care[1,2]. This procedure enables the delivery of oxygen, anesthesia, and medications, while also facilitating the removal of secretions and protecting the airway from pulmonary aspiration[3].

Despite advances in airway management devices, unanticipated difficult intubation remains a significant challenge, posing life-threatening risks during anesthesia or acute clinical situations[4,5]. Failure to adequately manage the upper airway is associated with significant morbidity and mortality[6]. The incidence of difficult

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tracheal intubation in elective surgeries ranges from approximately 1–2%, increasing to between 11 and 50% in emergency or urgent conditions outside the operating room[7].

Direct laryngoscopy (DL) has always been the traditional technique to perform tracheal intubation, but it has several limitations[8]. In particular, DL often fails to provide an optimal view of the glottis, especially in patients with anatomical variations such as a short neck, micrognathia, or macroglossia[6]. These factors can make intubation not only difficult but also potentially dangerous, increasing the risk of airway trauma and complications during and after airway management[9–11].

In response to these challenges, videolaryngoscopy (VL) has emerged over the past three decades as an advanced technique to facilitate tracheal intubation and is now recommended as the *"gold standard"* for airway management in all recent airway management guidelines[12–15]. This method employs devices equipped with a fiber-optic camera integrated into the blade of the laryngoscope, providing a clear and detailed view of the patient's laryngeal inlet on a monitor[8]. This technology offers numerous advantages, including real-time visualization of the glottis, thereby improving the accuracy and safety of intubation[16,17]. One of the main strengths of VL is its ability to position the operator's eye at the tip of the blade, just 2–3 cm from the laryngeal inlet, effectively allowing them to *"see around the corner"* and better visualize anatomical structures[18]. These features contribute to reducing the number of intubation attempts and increasing *"first-pass success"* rates[19–21], while also decreasing the level of difficulty as assessed by the Cormack-Lehane classification[22]. Consequently, VL reduces the risk of airway trauma and improves the overall experience for both patients and clinicians.

Various studies have widely demonstrated the superiority of VL compared to DL for glottis visualization, especially in cases of difficult intubation[7,23–30].

This has led to a true revolution in the approach to intubation, leading to the development and commercialization of a wide variety of devices in recent years, each with different features[31–33].

Moreover, the blade curvature in a videolaryngoscope has been diversified from a standard Macintosh-type (Macintosh geometry videolaryngoscopy- Mac-VL: ~ 30 degrees) and intermediate-type (between 30 and 60 degrees) to hyper-angulated types (Hyper-angulated or hyper-curved blade videolaryngoscopy- HA-VL: ~ 60 degrees), each differing in thickness and shapes, which result into different practical performances[34,35].

HA-VL have demonstrated superiority over Mac-VL in anticipated difficult airways, although no significant differences have been shown in the context of routine tracheal intubation in adults[36].

Moreover, comparisons between intermediate-angled and hyper-angulated devices have not been sufficiently investigated by existing literature. While HA-VL like the GlideScope and Mac-VL have been extensively studied, intermediate-angled devices such as the UED-A represent a relatively novel category with distinct blade geometry that may impact intubation performance differently.

To address this gap, we conducted a prospective randomized controlled trial to evaluate the effectiveness of a new intermediate-angled videolaryngoscope (UED-A) compared to a HA-VL (Glidescope) during elective tracheal intubation. The main outcome was to compare the performance of these videolaryngoscopes in terms of success rate, total time of tracheal intubation and number of attempts. Our primary hypothesis was that the total time to intubation using UED-A would be not inferior to Glidescope.

Secondary outcomes included the need for external glottic manipulation, Cormack-Lehane grade, operators' satisfaction grade and incidence of adverse events.

Materials and methods

A prospective, randomized controlled clinical study involving patients eligible for General Anesthesia (GA) undergoing tracheal intubation before elective surgery was conducted between February 2023 and May 2023.

This study was approved by the Ethics Committee of the University Hospital Campus Bio-Medico of Rome (protocol number 72/22, date of approval: 21 December 2022) and prospectively registered on ClinicalTrials.gov (TRN: NCT05721690, Registration date: February 1, 2023).

Inclusion criteria involved age over 18 years and American Society of Anesthesiologists (ASA) physical status classification I-III. Exclusion criteria included patients requiring an awake fiberoptic intubation[13], ASA class IV, age < 18 years, patients with predictors of difficult laryngoscopy (inter-incisor distance < 3 cm, severe limitation of cervical mobility, lingual deformities, anatomical neck abnormalities) and patients undergoing cardiac or otorhinolaryngologic surgery[37,38].

Eligible patients were randomly allocated into two groups to receive tracheal intubation with UED-A videolaryngoscope (UED-A group) or with GlideScope videolaryngoscope (GlideScope group).

Randomization was achieved using computer-generated lists in blocks of five with a 1:1 ratio, and treatment allocation was concealed using consecutively numbered, sealed, opaque envelopes.

To minimize the risk of operator-related bias during the procedure, the described techniques were always performed by the same anesthesiological team, consisting of four anesthesiologists experienced in airway management and tracheal intubation using videolaryngoscopes. Written informed consent was obtained by each patient before enrolment.

Collected data included age, gender, weight, height, Body Mass Index (BMI) (kg/m^2), inter-incisor distance (cm), neck extension (°), thyromental distance (cm), Mallampati score (I–III) and El-Ganzouri Risk Index (EGRI).

After a pre-oxygenation phase for 3 min using a face mask (FiO_2 100%), GA was induced through the administration of Propofol 2.5 mg/kg to obtain a Bispectral Index (BIS) between 40 and 60, Fentanyl 200 mcg and Rocuronium 0.6 mg/kg to obtain a deep neuromuscular block as showed by neuromuscular monitoring (TOF 0, PTC < 2). At this point, VL was performed using either the UED-A or GlideScope, depending on the patient's group assignment. Once the glottis was successfully visualized, tracheal intubation was carried out by inserting a size 7 endotracheal tube for women or size 7.5 for men. Each tube was equipped with a flexible stylet shaped to match the curvature of the blade (60° for Glidescope and 42° for UED-A).

Additionally, a preliminary training phase was conducted for the investigators involved in the study on the use of the new UED-A videolaryngoscope. This included a theoretical lesson followed by practical tests on a SimMan simulation mannequin (Laerdal Medical). On the other hand, the GlideScope videolaryngoscope has been routinely used for several years in our hospital by the entire anesthesiological team, including the investigators participating to this study. Thus, each team member had prior clinical experience with both the hyperangulated GlideScope and the intermediate-angled UED-A devices, ensuring familiarity with the techniques and minimizing operator-related bias.

The main outcome of our study was to compare the performance of two videolaryngoscopes in terms of success rate and total time of tracheal intubation, number of attempts, time to glottic visualization. Secondary outcomes included the need for external glottic manipulation—BURP (Backward-Upward-Rightward-Pressure) and the evaluation of quality of glottic visualization assessed by recording the Cormack-Lehane grade, the ease of use of the videolaryngoscopes, evaluated through an operator satisfaction score on a numerical scale from 0 to 10 (0 represents the worst experience ever with a video laryngoscope and 10 represents the best experience ever with a video laryngoscope) and lastly the safety of the videolaryngoscopes, including documentation of any episodes of desaturation and/or bleeding during the intubation.

Videolaryngoscopes

The UED-A videolaryngoscope (UE Medical Corp, Zhejiang, China- Fig. 1) is a new multifunctional device equipped with a single-use blade featuring a 42° angled tip with fiber optics. The images captured by the camera positioned at the tip of the blade are displayed in real-time and high definition on an external portable screen measuring 8 inches. It is designed to help during indirect laryngoscopies for both routine and difficult airway intubations and can therefore be used to facilitate tracheal intubation in GA during elective surgery, as well as for cardiopulmonary resuscitation during cardiac arrest.

The GlideScope videolaryngoscope[37] with LoPro blade (Verathon Medical, France- Fig. 2) has similar features to the aforementioned UED-A in terms of components, functionality, and applications but is distinguished by blades with a hyper-angulation of approximately 60°. Its use is widespread, making it one of the most studied and cited videolaryngoscopes in scientific literature[39].

Statistical analysis

Regarding primary outcome, we predefined a non-inferiority margin of 10 s, based on our clinical experience and in line with previous trials[40,41].

To calculate sample size using G*Power software, we considered our primary hypothesis, that total time to intubation with UED-A is not inferior to Glidescope. Based on previously published data regarding VL with Glidescope, we estimated the total time to intubation as mean 22.2 and SD 9[42,43]

Based on this information and assuming a two-sided significance level of 5%, we conducted 10,000 simulations, each with a sample size of 30 per group. According to this analysis, a total sample size of at least 60 patients was associated with 90% statistical power to detect group disparities in total time to intubation as minimal as 8 s. This value was chosen as a conservative assumption to ensure that the study was adequately powered even for smaller differences than the predefined margin.

A per-protocol technique was used for the statistical analysis. Continuous quantitative variables are presented as Mean ± Standard Deviation (SD), while discrete variables are expressed as the median and interquartile range (IQR). Qualitative variables are represented by the number of observations and the percentage distribution. The parametric distribution of numerical variables was assessed using the Shapiro–Wilk normality test. Group differences for continuous parametric variables were evaluated using Student's t-test, while the Wilcoxon–

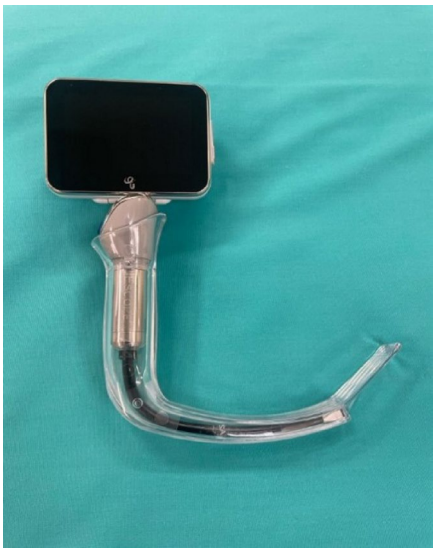

Fig. 1. UED-A videolaryngoscope.

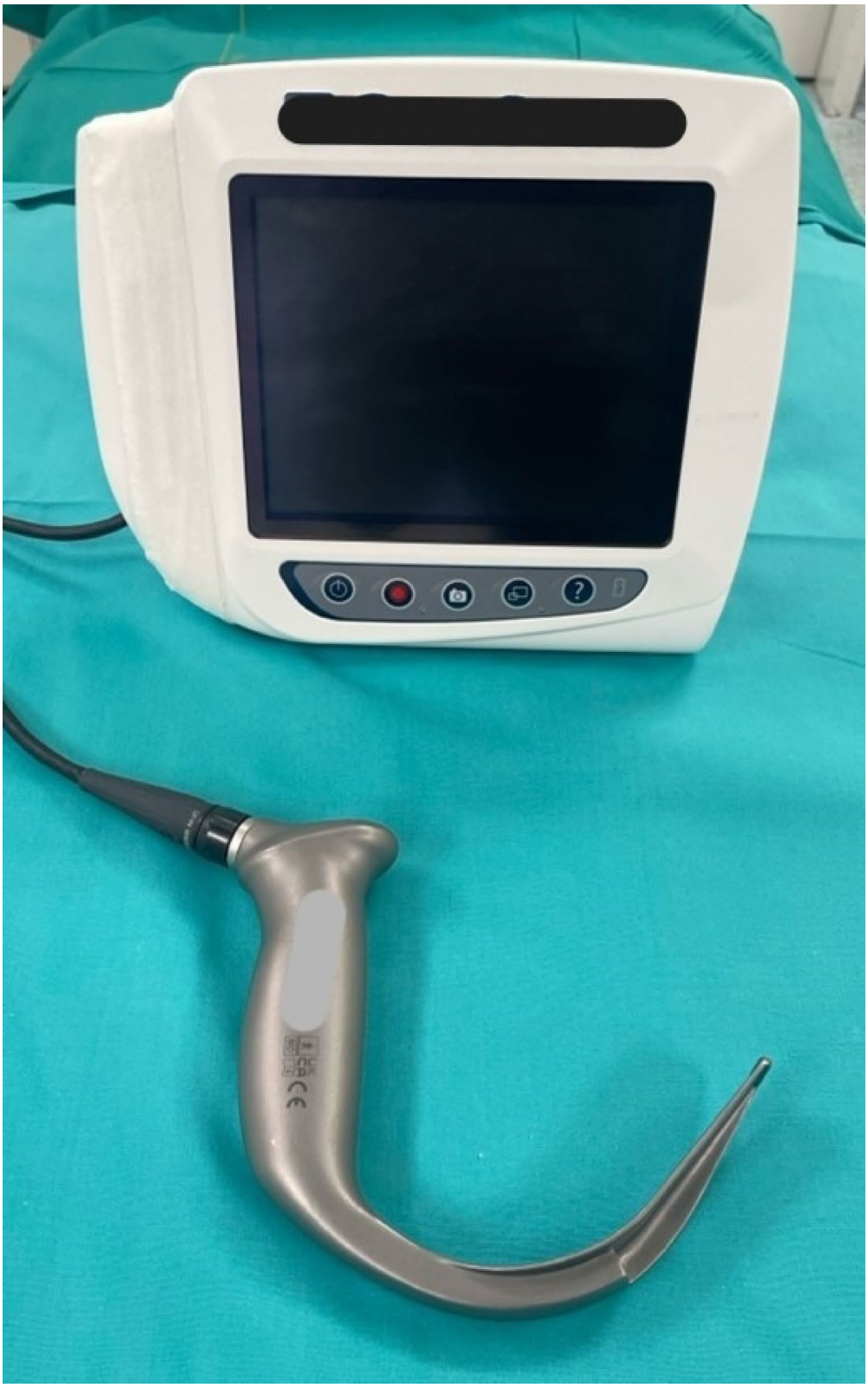

Fig. 2. GlideScope videolaryngoscope.

Mann–Whitney U test was employed when appropriate. Categorical variables were compared using Pearson's chi-squared test. For the primary and secondary continuous outcomes, mean differences between groups were reported together with 95% confidence intervals, calculated using Welch's t-test approximation, to assess non-inferiority against the predefined margin. Statistical significance was defined as a p-value < 0.05. Statistical

analysis and visual presentation were obtained using GraphPad Prism 8 software (GraphPad Software Inc., La Jolla, CA, USA).

Results

A total of 60 patients were included in the study, with 30 assigned to the UED-A group and 30 to the GlideScope group (Fig. 3). Patient characteristics are summarized in Table 1.

Patient characteristics are summarized in Table 1. TI was successfully performed in all enrolled patients. No significant differences were observed between the groups for the primary outcomes (Table 2).

The time to glottic visualization was similar between the two groups (UED-A: 12.9 ± 4.7 s; GlideScope: 13.5 ± 5.4 s; $p = 0.74$). Likewise, the total time required for TI did not differ significantly (UED-A: 30.9 ± 13.8 s; GlideScope: 29.5 ± 13.0 s; $p = 0.73$). The mean difference in total intubation time (UED-A – GlideScope) was 1.4 s, with a 95% confidence interval of − 5.6 to 8.3. Given the predefined non-inferiority margin of 10 s, the upper bound of the 95% confidence interval remained below the margin, thereby formally demonstrating non-inferiority of UED-A compared with GlideScope. In most cases, endotracheal tube placement was successful on the first attempt (UED-A: 93%; GlideScope: 97%; $p > 0.99$). In the remaining cases, a second attempt was required (UED-A: 7%; GlideScope: 3%; $p > 0.99$). No cases required a third attempt with fiberoptic assistance.

Regarding the secondary outcomes (Table 3), no statistically significant differences were observed in the need for the BURP maneuver (UED-A: 20%; GlideScope: 13%; $p = 0.73$) or in the Cormack-Lehane grade during tracheal intubation (UED-A: CL I 77%, CL II 20%; GlideScope: CL I 83%, CL II 17%; $p > 0.74$ and $p > 0.99$, respectively). A single case of Cormack-Lehane grade III was reported in the UED-A group, while no cases of grade IV were observed. No statistically significant differences were found in the incidence of adverse events related to videolaryngoscopy. One case of peri-procedural desaturation occurred in the GlideScope

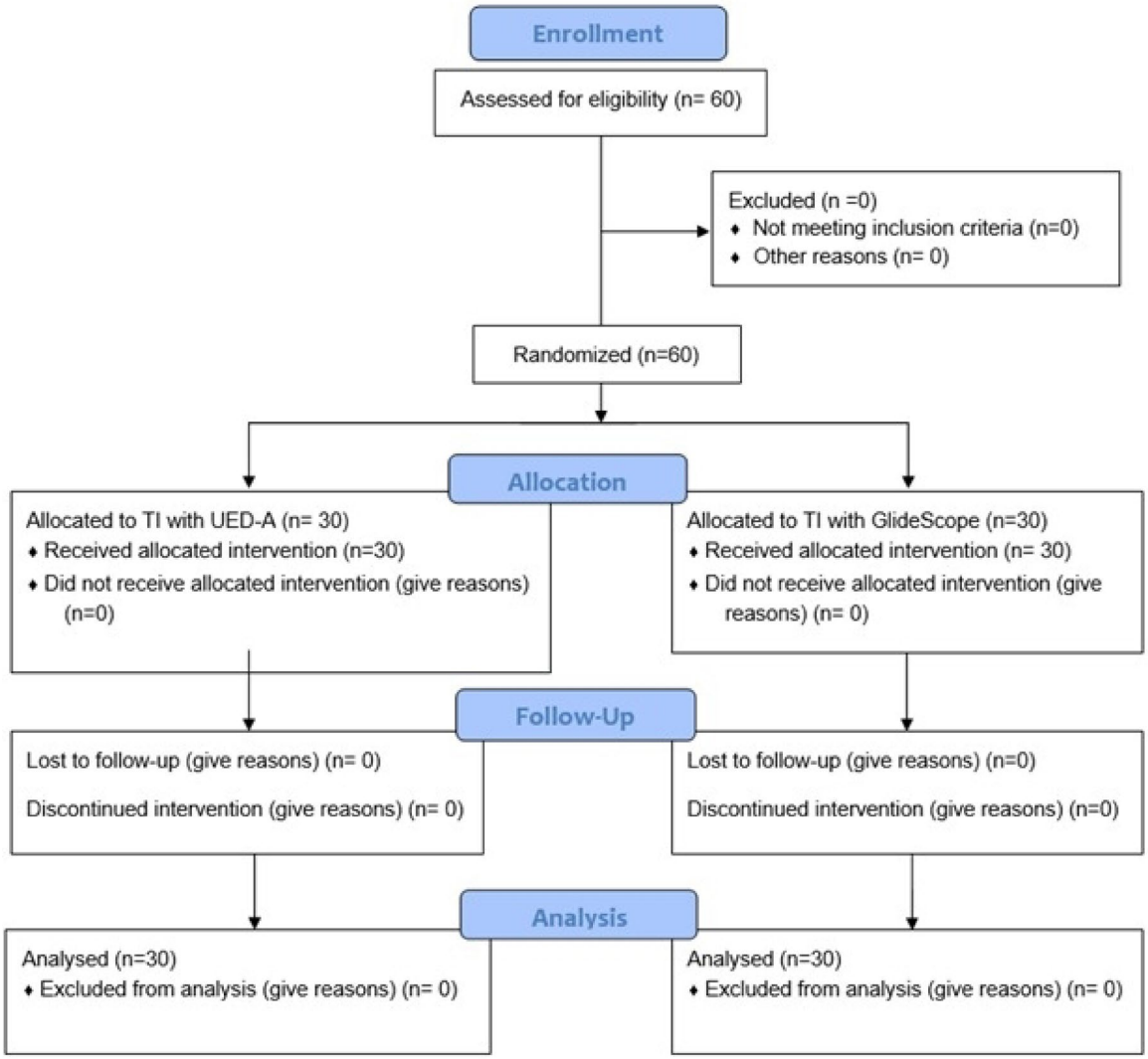

Fig. 3. Consolidated standards for reporting experiments (CONSORT) flowchart.

	UED-A ($n=30$)	GlideScope ($n=30$)	p-value
Age (yr)—mean ± SD	59 ± 16	60 ± 18	0.94
Gender (M/F)—%	13/17	16/14	0.6
BMI (kg/m^2)—mean ± SD	28.8 ± 5.9	27.9 ± 6.5	0.56
Inter-incisor distance (cm)—mean ± SD	4.2 ± 0.4	4.4 ± 0.6	0.31
Neck extension (°)—mean ± SD	92 ± 8	93 ± 8	0.45
Thyromental distance (cm)—mean ± SD	6.4 ± 0.3	6.6 ± 0.3	0.1
Mallampati score—%			
I	13 (43%)	13 (43%)	> 0.99
I	10 (33%)	13 (43%)	0.59
III	7 (24%)	3 (10%)	0.29
IV	0	1 (4%)	> 0.99
EGRI—%			
< 4	25 (83%)	28 (93%)	0.42
≥ 4	5 (17%)	2 (7%)	0.42

Table 1. Patients' characteristics and intubation data. *SD* Standard deviation, *BMI* Body mass index, *EGRI* El-Ganzouri risk index.

	UED-A ($n=30$)	GlideScope ($n=30$)	Mean Difference	p-value
TI total time (sec)—mean ± SD	30.9 ± 13.8 (95% CI 25.7–36.1)	29.5 ± 13 (95% CI 24.6–34.4)	+ 1.4 (95% CI − 5.6 to 8.3)	0.73
Time to Glottic Visualization (sec)—mean ± SD	12.9 ± 4.7 (95% CI 11.1–14.7)	13.5 ± 5.4 (95% CI 11.5–15.5)	− 0.6 (95% CI − 3.2 to 2.0)	0.74
TI success rate—%				
1° Attempt	28 (93%)	29 (97%)		> 0.99
2° Attempt	2 (7%)	1 (3%)		> 0.99

Table 2. Primary outcomes. *SD* Standard deviation, *TI* Tracheal Intubation.

	UED-A ($n=30$)	GlideScope ($n=30$)	p-value
Need for BURP—n. (%)			
Yes	6 (20%)	4 (13%)	0.73
No	24 (80%)	26 (87%)	0.73
Cormack-Lehane—n. (%)			
I	23 (77%)	25 (83%)	
II	6 (20%)	5 (17%)	0.74
III	1 (3%)	0	> 0.99
IV	0	0	> 0.99
Complications (n.):			
Post-laringoscopy bleeding (YES/NO)	0/30	0/30	–
Peri-procedural desaturation (YES/NO)	0/30	1/29	> 0.99
Operator satisfaction (NRS 0–10)—median (IQR)	9 (7.3–10)	8 (8–10)	0.59

Table 3. Secondary outcomes. *BURP* Backward-Upward-Rightward-Pressure.

group. Finally, operator satisfaction scores were comparable between the two groups [UED-A: 9 (IQR 7.3–10); GlideScope: 8 (IQR 8–10); $p=0.59$].

Discussion

Our study found no differences in routine tracheal intubation performance between a hyper-angulated (Glidescope) and intermediate-angled (UED-A) videolaryngoscope.

Since the development of tracheal intubation, DL has traditionally been regarded as the *gold standard* for most patients. However, over time, negative outcomes in airway management have been reported, often associated with increased patient morbidity and mortality[44].

In recent years, the evolution of VL has marked a significant advancement in anesthesiology practice[45]. Current airway management guidelines recognize the VL as the *gold standard* for performing tracheal intubation, both in elective settings and in challenging or emergencies situations where rapid sequence intubation (RSI) is crucial[12–15]. A statistical analysis over the past two decades (1993–1999 and 2000–2012) revealed that approximately 30% of adverse events related to anesthesiological management involve airway control[46]. Furthermore, unanticipated difficult airways are more common than generally assumed. A retrospective analysis of a 2015 Danish database with 188.064 tracheal intubation cases found that airway management difficulties occurred in 1.86% (3391 cases), of which 93% (3154 cases) were unanticipated[47]. However, an analysis of the Difficult Airway Society (DAS) database reported that difficult airway management was anticipated in 58% (391 cases) and unanticipated in 42% (284 cases)[48]. This findings highlight the significant likelihood of encountering a difficult airway, even in the absence of predictors or prior history.

Failure to successfully perform tracheal intubation in any context can lead to serious complications, including hypoxemia, pulmonary aspiration, arrhythmias, and critical situations of CICO (Cannot Intubate-Cannot Oxygenate)[14,49,50]. In the worst cases, these complications may lead to catastrophic outcomes such as death or permanent brain damage[51].

The growing body of evidence over the years has established the videolaryngoscope as an essential device in modern anesthesiological practices, leading to a continuously expanding market due to the increasing number of companies investing in the research and development of advanced airway management technologies[45,52].

Video devices have significantly improved the visualization of anatomical structures, particularly but not only in patients with difficult intubation criteria for direct laryngoscopy[17,53]. This has contributed to reduced intubation difficulties and shorter intubation times, increasing the *first-attempt success* rate when used with a flexible stylet, and a decrease in airway-related complications[18]. Among the devices, the McGrath and GlideScope videolaryngoscopes have been the most prominent in the field of indirect laryngoscopy. They are being extensively studied, well-validated by scientific literature, and widely used in clinical practice[54,55]. W.J. Jeon et al.[56] highlighted that the median time to intubation in patients with normal airways using the GlideScope with a hyper-angulated blade and McGrath with an intermediate-angled blade was 40.5 s and 53.3 s, respectively, which is comparable to the times reported in other studies[57–59]. However, unlike our study, the McGrath is considered inferior to the UED-A in terms of screen quality and glottic image resolution. In this regard, Van Zundert et al.[58] reported that using the GlideScope and McGrath associated with a styletted endotracheal tube (ETT) increased first-pass success rates in healthy adult patients, from 53 to 76% and 52 to 74%, respectively. Similarly, Sun et al.[60] reported a 94% first-pass success rate with the GlideScope and a styletted ETT. Rai et al.[57] demonstrated that the GlideScope improved laryngeal visualization and facilitated successful TI. A key advantage of videolaryngoscopy is the ability to display the laryngeal view on a monitor, which not only provides better visual support for the operator but also allows multiple team members to simultaneously observe the laryngeal inlet[61]. This feature enhances teamwork and serves as an effective training and educational tool for healthcare professionals[62]. Additionally, the use of videolaryngoscopes is clearly linked to a reduction in intubation-related complications. Studies bt Lewis et al.[9] and Hansel et al.[8] have highlighted decreased episodes of hypoxia, reduced airway trauma, and better recognition of inadvertent esophageal intubation when using videolaryngoscopes.

The rationale of our study is based on the concept that current literature supports the superiority of the HA-VL versus the Mac-VL for videolaryngoscopes in patients with anticipated difficult airways[34], but no such evidence exists for patients undergoing routine VL without predicted airway difficulties. Similarly, there is a lack of evidence favoring HA-VL over videolaryngoscopes with intermediate blade geometry. Notably, the Canadian Airway Focus Group (CAFG)[14], regarding the management of unanticipated airway difficulties in already unconscious patients, recommends routine primary use of VL with an appropriate blade type for all tracheal intubations without specifying a preferred blade geometry. Moreover, direct comparisons between intermediate-angled and HA-VL remain scarce in the existing literature. Most previous studies have focused on contrasting HA-VL with Mac-VL, leaving a significant gap regarding the clinical performance differences between intermediate-angled and hyperangulated blades. This lack of data limits clear guidance for clinicians on optimal blade selection in routine airway management. Our study aims to address this gap by providing prospective randomized evidence comparing these two blade geometries in patients without anticipated difficult airways.

The HA-VL allows "*around the corner*" visualization of the glottis through indirect videoscopic imaging, providing a view superior to that achieved with DL[8] or Mac-VL[34]. However, directing the endotracheal tube toward the laryngeal inlet can sometimes be challenging with a HA-VL. To address these difficulties during routine tracheal intubation, the CAFG recommends that anesthesiologists consider switching to a non-hyper-angulated blade if attempts with the hyper-angulated blade are unsuccessful.

Furthermore, although HA-VL provide improved glottic visualization, they require the use of a stylet with a greater degree of angulation compared to Mac-VL[63,64]. R. Wakabayashi et al. demonstrated that stylet angulation at the holding position improves the maneuverability of the tracheal tube and enables easy, smooth, and swift tube placement during tracheal intubation with a McGRATH MAC videolaryngoscope[65]. Similarly, J. Lee demonstrated that when intubating patients with the McGrath videolaryngoscope, the 60° angled stylet al.lowed for faster tracheal intubation than the 90° angled stylet[66].

However, this could make tracheal intubation more challenging for operators who lack extensive experience with hyper-angulated devices. In this regard, the need to shape the stylet to match the curvature of the specific hyper-angulated blade adds a layer of operator-dependent variability to clinical practice. This variability may influence both the success rate and time to intubation, as improper stylet shaping can lead to difficulties in advancing the tube through the vocal cords, potentially prolonging the procedure or increasing the number of attempts needed.

This issue may help explain why, despite the increased global availability of videolaryngoscopes following the surge in purchases during the the Coronavirus disease 2019 pandemic, their use in clinical settings have not yet reached their full potential. Several obstacles to widespread adoption remain, including insufficient training, concerns about de-skilling in DL, equipment and cleaning costs, and environmental impact, among others. It is now evident that in order for patients to fully benefit from the technology and for airway managers to fully understand its role in daily practice, appropriate training and education are essential[67]. In particular, proper training in the correct shaping and handling of stylets is crucial to optimize clinical outcomes and to fully leverage the advantages offered by VL.

In this context, an important consideration in videolaryngoscopy is the potential discrepancy between achieving an optimal glottic view and the actual ease of tracheal tube advancement—the so-called *"can see but can't intubate"* scenario. Although this issue did not occur in our cohort, it represents a well-recognized challenge in clinical practice. Fernández-Vaquero et al.[68] have explored this phenomenon, highlighting that even with high-quality glottic visualization (e.g., elevated POGO scores), intubation may still be technically difficult. Their findings underscore that optimal visualization does not necessarily translate into procedural ease, emphasizing the importance of comprehensive pre-procedural assessment, anticipation of potential difficulties, and appropriate preparation.

However, our study has some limitations. Firstly, we considered a relatively small sample size (60 patients in total), although justified by an "a priori" power analysis. A larger sample size could have included a greater number of patients with anticipated difficult intubation, which would have certainly represented an interesting opportunity for subgroup analysis. Additionally, we assessed glottic visualization using the Cormack–Lehane classification rather than videolaryngoscopy-specific scores such as the Percent Of Glottic Opening (POGO) or Video Classification of Intubation (VCI) scores[69], which may have offered a more precise evaluation tailored to this technique. Incorporating such videolaryngoscopy-specific scores in future studies could enhance the accuracy and clinical relevance of glottic visualization assessment. This limitation further underscores the importance of adopting unified classification and evaluation systems for videolaryngoscopes, as recently emphasized by M. Á. Gómez-Ríos et al.[70], which advocates for the development of standardized frameworks for the assessment and documentation of VL performance.

Bias may have been occurred since it was not possible to blind the anesthesiologist to the device being used. Additionally, all tracheal intubations were performed by experienced anesthesiologists; therefore, the findings may not be generalizable to less experienced operators. We explicitly acknowledge the lack of operator blinding and the resulting performance bias as important limitations of this study. Lastly, the study population was limited to elective surgical patients with normal airways, which restricts the applicability of the results to patients with anticipated difficult airways. Therefore, future studies should focus on larger sample sizes and investigate the use of the UED-A device in patients with predicted difficult airways, such as those with an El-Ganzouri Index greater than 4.

Conclusion

In this randomized controlled trial, the UED-A videolaryngoscope demonstrated performance and safety comparable to Glidescope for routine tracheal intubation in adults with normal airway anatomy undergoing elective surgery. Given its intermediate blade angulation, ease of use, and satisfactory operator feedback, the UED-A represents a valid, safe, and effective alternative to hyperangulated blades for routine videolaryngoscopy in this patient population. However, due to the limited sample size and exclusion of patients with difficult airways, these findings should be interpreted with caution. Further research is needed to evaluate the performance of the UED-A in patients with predicted difficult airways or in emergency settings.

Data availability

The data used and/or analyzed during the study are available from the corresponding author upon reasonable request via email.

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Author contributions

All authors contributed to the conception and design of the study, analysis of the data, and overall development of the manuscript. SM was primarily responsible for drafting the manuscript and coordinating the writing process. AS and FC significantly contributed to the drafting and critical revision of the text. GP and AR supported manuscript preparation by contributing to the interpretation and presentation of results. LS and AM participated in data handling and contributed content for specific sections of the manuscript. MC and RC provided supervisory input and revised the text for important intellectual content. FEA oversaw the study and contributed to the critical review of the manuscript. GP contributed to the design of the study, interpretation and presentation of results and provided final approval of the version to be submitted.

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Declarations

Competing interests

The authors declare no competing interests.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and

its later amendments or comparable ethical standards.

Human and animal rights

Patients' characteristics and intubation data.

Additional information

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