



Should videolaryngoscopy enter routine use? Unanticipated difficult airway: A five-year experience in a tertiary care hospital

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■ MAIN POINTS

- VL significantly improved glottic visualization in patients with UDA, reducing the median Cormack-Lehane grade from 3 (DL) to 1 (VL) ($p < 0.001$).
- VL achieved a 97% success rate in patients who could not be intubated with DL, suggesting its strong effectiveness as more than just a rescue tool.
- Compared to DL, VL was associated with significantly lower rates of esophageal intubation (1.5% vs. 9.8%) and oropharyngeal injury (2.3% vs. 11.9%) ($p < 0.001$), demonstrating its potential to reduce airway-related complications.
- The study supports the consideration of VL as a first-line technique for airway management, especially in patients with normal airway assessment but unexpected intubation difficulty.
- Routine use of VL may improve patient safety and overall intubation success in UDA cases, warranting its broader integration into airway management protocols.

■ ABSTRACT

Aim: An unanticipated difficult airway (UDA) can be very challenging for anesthesiologists in airway management and, if not managed appropriately, may lead to increased morbidity and even mortality in patients. Because patients with normal physical examination findings may also have a difficult airway, meticulous preparations are essential for every patient. Our study investigated the five-year outcomes of a tertiary care hospital in patients with UDA.

Materials and Methods: We retrospectively reviewed the records of 143 patients with UDA who underwent surgery under general anesthesia between January 2020 and March 2025. We evaluated their airway management: preoperative physical examination findings, demographics, comorbidities, mask ventilation, laryngoscopic visualization, and tracheal intubation success.

Results: We found that videolaryngoscopy (VL) improved glottic visualization compared to direct laryngoscopy (DL) in patients with UDA ($p < 0.001$). VL reduced the risk of complications and accidental esophageal intubation compared to DL ($p < 0.001$, $p < 0.001$, respectively). We also found that 129 out of 133 patients (97%) who could not be intubated with DL were successfully intubated endotracheally using VL.

Conclusion: VL improves glottic visualization, reduces the risk of complications, and increases the rate of successful intubation compared to DL in patients with UDA.

Keywords: Anesthesia, Airway management, Difficult airway, Intubation, Laryngoscopy, Videolaryngoscopy

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■ INTRODUCTION

Airway management is a cornerstone of safe anesthesia practice and is usually achieved by endotracheal intubation. A difficult airway is defined as challenges in mask ventilation, laryngoscopic visualization, tracheal intubation, or the need for an emergency surgical airway [1,2]. Among these, UDA is particularly critical, as it occurs in patients without identifiable predictors during preoperative evaluation [3,4]. If not promptly recognized and managed, UDA may result in hypoxemia, airway trauma, and even mortality [5].

Preoperative predictors such as Mallampati classification, thyromental distance, interincisor gap, neck mobility, and upper lip bite test are commonly used but have limited sensitivity and specificity [6–8]. Thus, patients with apparently normal examinations may still present with unexpected difficulties, highlighting the need for structured airway management strategies and access to alternative devices [9,10].

When intubation fails, maintaining oxygenation becomes the priority. International guidelines recommend adjuncts such as VL, supraglottic devices, or flexible intubation scopes be-

fore invasive techniques or awakening the patient [3,11]. VL provides an indirect view of the glottis, improves visualization in difficult cases, and reduces esophageal intubation and airway trauma [12–14]. However, limitations such as cost, reduced effectiveness in restricted mouth opening, and tube delivery challenges remain [15].

VL has been incorporated into national and international difficult airway guidelines [4,16], but its role as a first-line tool rather than a rescue device is still debated, especially in UDA cases.

The present study analyzed a five-year experience in a tertiary care center, focusing on the role of VL compared to DL in UDA. Specifically, we investigated its effects on glottic visualization, intubation success, and airway-related complications.

■ MATERIALS AND METHODS

Ethical approval for this study was received from Tokat Gaziosmanpaşa University Clinical Research Ethics Committee (25-MOBAEK-124) on April 8, 2025, and the retrospective observational study was registered at ClinicalTrials.gov (NCT06972394) on May 13, 2025. This study was designed as a retrospective observational study and was conducted in accordance with the STROBE guidelines for observational studies and the principles of the Declaration of Helsinki.

Study population and sampling

Data on patients with UDA who underwent elective surgery under general anesthesia between January 2020 and March 2025 were obtained by reviewing hospital automation systems, patient records, and difficult airway forms. All eligible cases during this period were included consecutively (non-probability consecutive sampling). We excluded patients with missing data, a history of difficult airway, or known difficult airway findings. No randomization or blinding was performed due to the retrospective nature of the study.

Outcomes

The primary outcome was the success rate of tracheal intubation with VL compared with DL. Secondary outcomes included glottic visualization (Cormack–Lehane grade), complications such as esophageal intubation and oropharyngeal injury, and intubation difficulty scores (IDS).

Airway management protocol

In our clinic, preoperative airway evaluation includes assessment of Mallampati classification, thyromental distance, sternomental distance, interincisor gap, neck circumference, upper lip bite test, neck mobility, dentition, hoarseness, exertional dyspnea, and history of previous difficult airway. Patients without predictors of a difficult airway underwent routine intubation using DL in the sniffing position.

Management of patients with UDA was carried out according to a specific protocol. The C-MAC® D-Blade (Karl Storz,

Tuttlingen, Germany) VL with a hyper-angled blade was used as a rescue technique in patients who could not be intubated with DL, provided that mask ventilation and oxygenation were maintained. If tracheal intubation could not be achieved with VL and the patient was awakened, awake flexible intubation scope (FIS) was planned when general anesthesia was required.

Mask ventilation difficulty was classified as Class I–IV. IDS was calculated by evaluating seven variables, and a score greater than five indicated difficult intubation [16].

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA), licensed through Tokat Gaziosmanpaşa University. The normality of distribution for quantitative variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Normally distributed continuous variables were summarized as mean $\pm$ standard deviation, while non-normally distributed variables were expressed as median (minimum–maximum). Categorical variables were presented as numbers and percentages.

Comparisons of categorical variables such as intubation success, esophageal intubation, and oropharyngeal injury between groups were performed using Fisher’s Exact Test or Pearson’s Chi-Square Test, with continuity correction where appropriate. Paired comparisons of Cormack–Lehane scores between DL and VL in the same patients were conducted using the non-parametric Wilcoxon Signed-Rank Test. Correlation analyses were performed using Spearman’s rho (r). However, due to the study design, in which all patients initially underwent DL and only those with failed DL were subsequently managed with VL, the two groups were not statistically independent. Therefore, while group comparisons were performed as described, the results should be interpreted with caution given this dependency.

All tests were two-tailed, and a p-value <0.05 was considered statistically significant. Exact p-values are reported in the results and tables.

■ RESULTS

We evaluated 355 patients for the study. 201 patients had a difficult airway findings or history, while 11 had missing data. The study included 143 patients. Figure 1 shows the study’s flow chart. The median (min–max) patient age was 53 years (18–75 years), with 57% being male. Fifty-eight patients were smokers, 46 had hypertension, 32 had diabetes mellitus, and 22 had chronic lung disease. The patients’ demographic data and descriptive characteristics are in Table 1.

In our study, DL was initially attempted in all 143 patients with UDA. Among these, successful intubation was achieved in 10 cases using DL. The remaining 133 patients, in whom DL failed, were subsequently intubated using VL. VL was

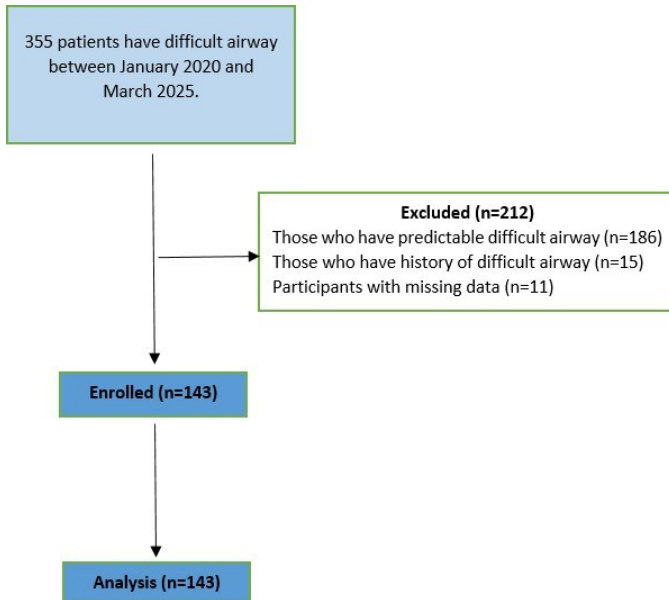


Figure 1. Flow diagram of the study.

Table 1. Baseline characteristics and clinical outcomes of the study population.

Age (years)	53 (18 – 75)
Sex (Female / Male), n (%)	61 / 82 (43 / 57)
BMI (kg/m ²)	27.77 (19.1 – 29.78)
ASA (I / II / III), n (%)	42 / 84 / 17 (29 / 59 / 12)
Hypertension, n (%)	46 (32)
Diabetes, n (%)	32 (22)
Ischemic heart disease, n (%)	17 (12)
Chronic lung disease, n (%)	22 (15)
Thyroid disease, n (%)	7 (5)
Cerebral vascular disease, n (%)	3 (2)
Neoplasm, n (%)	13 (9)
Rheumatic disease, n (%)	20 (14)
Smoking, n (%)	58 (41)
Chronic kidney disease, n (%)	3 (2)
Mallampati classification (I / II), n (%)	54 / 89 (38 / 62)
Neck circumference (normal), n (%)	143 (100)
Upper lip bite test (1 / 2), n (%)	103 / 40 (72 / 28)
Thyromental distance (normal), n (%)	143 (100)
Neck mobility ($\geq 80^\circ$), n (%)	143 (100)
Interincisor gap ≥ 3.5 cm, n (%)	143 (100)
IDS	7 (6 – 9)
Difficult mask ventilation (I / II / III), n (%)	85 / 52 / 6 (59 / 37 / 4)

BMI: body mass index; ASA: American Society of Anesthesiologists; IDS: intubation difficulty scale; quantitative data are given as median (minimum – maximum).

successful in 129 of these cases, while 4 patients could not be intubated with either method and were awakened. These four patients were awakened and prepared for elective awake intubation with preservation of spontaneous breathing, and successful tracheal intubation was achieved using the FIS.

The overall intubation success rate was 7% with DL and 97% with VL, and this difference was statistically significant ($p < 0.001$) (Table 2). However, it is important to emphasize that the groups were not independent. Since VL was used only in patients where DL had already failed, this indicates a selection of more difficult cases in the VL group. Therefore,

the remarkably high success rate of VL, suggests not only a statistically but also a clinically significant advantage of VL.

The median (min–max) Cormack-Lehane grade value was three (2–4) in DL and one (1–3) in VL (Table 2). VL significantly decreased the Cormack-Lehane grade compared to DL ($p < 0.001$), (Table 2). This supports the advantage of VL in providing better visualization of the glottic structures.

Seventeen of 143 patients (11.9%) in DL and three of 133 patients (2.3%) in VL had oropharyngeal injury during attempted endotracheal intubation (Table 2). VL significantly reduced the risk of complications compared to DL ($p < 0.001$) (Table 2). We observed esophageal intubation during endotracheal intubation attempts in 14 of 143 patients (9.8%) with DL and two of 133 patients (1.5%) with VL (Table 2). VL significantly decreased the risk of accidental esophageal intubation compared to DL ($p < 0.001$) (Table 2).

The patients had a median (min–max) IDS value of seven (6–9). All patients had an IDS score above five, indicating difficult intubation. In the current study, the incidence of difficult airway in elective surgeries was found to be 1.97%, while the incidence of UDA was found to be 0.79%. In addition, mask ventilation was easy in 85 patients (59.4%), moderately difficult in 52 (36.4%), and highly difficult in six (4.2%), while none had impossible mask ventilation.

The relationship between the parameters in airway management was as follows (Table 3): We found a moderate positive correlation between IDS score and mask ventilation difficulty, oropharyngeal injury in DL, and esophageal intubation in DL; a weak positive correlation between IDS score and CL score in DL, CL score in VL, esophageal intubation in VL, and oropharyngeal injury in VL; and a weak negative correlation between IDS score and intubation success in VL and intubation success in DL.

There was a weak positive correlation between mask ventilation difficulty and CL score in DL, oropharyngeal injury in DL, oropharyngeal injury in VL, esophageal intubation in VL, and esophageal intubation in DL; and a weak negative correlation between mask ventilation difficulty and intubation success in VL.

There was a good negative correlation between CL score and intubation success in DL; a weak positive correlation between CL score in DL and oropharyngeal injury in VL, oropharyngeal injury in DL, esophageal intubation in VL, and esophageal intubation in DL; and a weak negative correlation between CL score in DL and intubation success in VL. We found a moderate positive correlation between CL score in VL and esophageal intubation in DL; a weak positive correlation between CL score in VL and oropharyngeal injury in VL, oropharyngeal injury in DL and esophageal intubation in VL; and a moderate negative correlation between CL score in VL and intubation success in VL.

There was a strong positive correlation between oropharyngeal injury in VL and esophageal intubation in VL; a moder-

Table 2. Comparison of the effects of different laryngoscopes on airway management.

	Direct Laryngoscopy	Videolaryngoscopy	p
CL score, median (min-max)	3 (2 - 4)	1 (1 - 3)	<0.001 ^{a*}
Successful intubation, n (%)	10 (7)	129 (97)	<0.001 ^{b*}
Esophageal intubation, n (%)	14 (9.8)	2 (1.5)	<0.001 ^{c*}
Oropharyngeal injury, n (%)	17 (11.9)	3 (2.3)	<0.001 ^{c*}

^a: Wilcoxon Signed Ranks; ^b: Fisher's Exact test; ^c: Pearson Chi-Square test; *: statistically significant; CL: Cormack-Lehane classification; Quantitative data are given as median (minimum - maximum).

Table 3. Relationship between difficulties in airway management, tracheal intubation success and complications.

	IDS	Difficult mask ventilation	CL score with DL	CL score with VL	Oropharyngeal injury with VL	Oropharyngeal injury with DL	Esophageal intubation with VL	Esophageal intubation with DL	Successful intubation with DL	Successful intubation with VL
IDS	rho p									
Difficult mask ventilation	rho p	0.516* <0.001								
CL score with DL	rho p	0.251* 0.003	0.231* 0.005							
CL score with VL	rho p	0.368* <0.001	-0.089 0.308	0.073 0.401						
Oropharyngeal injury with VL	rho p	0.241* 0.005	0.246* 0.004	0.328* <0.001	0.360* <0.001					
Oropharyngeal injury with DL	rho p	0.552* <0.001	0.380* <0.001	0.234* 0.005	0.271* 0.002	0.417* <0.001				
Esophageal intubation with VL	rho p	0.206* 0.022	0.212* 0.006	0.208* 0.016	0.290* 0.001	0.813* <0.001	0.323* <0.001			
Esophageal intubation with DL	rho p	0.455* <0.001	0.248* 0.003	0.229* 0.006	0.504* <0.001	0.443* <0.001	0.606* <0.001	0.360* <0.001		
Successful intubation with DL	rho p	-0.217* 0.011	-0.072 0.390	-0.616* <0.001			-0.101 0.231		-0.090 0.283	
Successful intubation with VL	rho p	-0.266* 0.002	-0.208* 0.013	-0.297* 0.001	-0.403* <0.001	-0.566* <0.001	-0.460* <0.001	-0.340* <0.001	-0.513* <0.001	

rho: Spearman's rho correlation coefficient; *: p < 0.05. (IDS: intubation difficulty scale; DL: direct laryngoscopy; VL: videolaryngoscopy; CL: Cormack-Lehane classification).

ate positive correlation between oropharyngeal injury in VL and oropharyngeal injury in DL and esophageal intubation in DL; and a moderate negative correlation between oropharyngeal injury in VL and intubation success in VL. We found a good positive correlation between oropharyngeal injury in DL and esophageal intubation in DL, a low positive correlation between oropharyngeal injury in DL and esophageal intubation in VL, and a moderate negative correlation between oropharyngeal injury in DL and intubation success in VL.

There was a weak positive correlation between esophageal intubation in VL and esophageal intubation in DL; and a weak negative correlation between esophageal intubation in VL and intubation success in VL. We also found a moder-

ate negative correlation between esophageal intubation in DL and intubation success in VL.

■ DISCUSSION

UDA presents a significant challenge for practitioners and is one of the leading causes of increased morbidity associated with anesthesia. Especially when not properly managed, it can lead to complications that may result in patient death. Our study showed that VL improves glottic visualization and increases endotracheal intubation success compared to DL in UDA. We also found that VL reduced the risk of oropharyngeal injury and esophageal intubation compared to DL.

A preoperative comprehensive airway evaluation, along with

diagnostic imaging when necessary, assessment of the patient's physiological status (including apnea tolerance, aspiration risk, and hemodynamic status), and a review of the patient's previous airway management history provide valuable information for identifying potential difficult airways. However, a difficult airway can also be seen in patients with normal screening tests. The use of VL should be considered in patients with difficult intubation on DL, as it facilitates endotracheal intubation and increases the success rate [17].

VL has been included in airway management guidelines as its benefits have become more recognized over time, and its prevalence and familiarity with its use have increased [4,13]. Many studies have suggested including VL in routine clinical practice in airway management rather than used in failed intubation with DL [13,18,19]. VL is also an alternative to flexible bronchoscopy in awake intubation of appropriate patients [20]. Studies have reported that it provides advantages in increasing intubation success, reducing the rate of difficult laryngoscopy and improving glottic visualization, reducing airway trauma and the risk of hypoxia, and defining esophageal intubation better [17,21]. Nevertheless, the high cost, lack of familiarity with its use, lens fogging, and secretions and blood obstructing the camera's view limit VL use [9]. In addition, VL is not recommended if the mouth opening is limited (<2.5 cm), the cervical spine is fixed in flexion, and there is a tumor in or near the airway accompanied by stridor [14]. Consistent with the literature, the present study showed that VL improved glottic visualization, reduced the risk of complications, and increased the rate of successful intubation compared to DL in patients with UDA.

Patients with difficult or failed tracheal intubation are more likely to have difficult mask ventilation, and patients with difficult mask ventilation are more likely to have difficult or failed tracheal intubation [22,23]. Similarly, patients with failed supraglottic airway ventilation have been shown to have a higher incidence of difficult face mask ventilation [24]. This is referred to as "compound failure of airway management" as tracheal intubation and mask ventilation share common predictors of difficulty [22]. In our study, 40.6% of the patients experienced difficulty in mask ventilation (36.4% moderately difficult, 4.2% highly difficult), which is higher than the literature [2,3]. This may be because all patients in the study had difficult intubation [22,23].

Awake intubation with preservation of the patient's spontaneous breathing should be considered as a potentially safer option when difficulty is anticipated in two or more of the airway management stages. Intubation with awake FIS performed by experienced people has been reported to have a high success and low complication rate under appropriate conditions and in appropriate patients [25]. We found four patients with failed tracheal intubation with both DL and VL were successfully intubated using FIS, with no complications observed.

The risk of airway-related complications (esophageal intubation, aspiration, and oropharyngeal damage) is higher in

patients with difficult intubation compared to others and is reported to vary between 4.1% and 28% [26]. In the present study, the rate of airway-related complications was 23.1% (esophageal intubation 9.1%, oropharyngeal injury 14%), consistent with the literature. Of these complications, 84.8% occurred in DL and 15.2% in VL.

In the study conducted by Norskov et al., the incidence of UDA was reported as 1.87% [27]. Alemdar et al. found that 24.9% of adult patients with difficult airways had UDA [28]. Furthermore, Endlich et al. reported that in 10% of difficult or failed intubation cases, no predictive factor could be identified [29]. In the present study, the incidence of difficult airway in elective surgeries was found to be 1.97%, while the incidence of UDA was 0.79%.

Limitations

Our study has some limitations worth mentioning. Firstly, it was retrospective. However, a prospective study is unlikely to be performed in these patients as difficult airways cannot be predicted. Secondly, the airway evaluation was based solely on the patient's physical examination findings and anesthesia history. Advanced assessment methods such as ultrasound, awake nasal endoscopy, or oral videolaryngoscopy, which could provide more detailed information regarding airway anatomy and management, were not utilized in this study. These imaging and evaluation techniques may offer potential benefits in reducing the incidence of UDA. However, their routine use in many clinical settings is significantly limited due to being time-consuming and cost-prohibitive. Thirdly, this study focused solely on patients undergoing elective surgery. The incidence of difficult airways and associated complications may be higher in emergency surgical cases. Another limitation is that all patients were from a single center, and only the C-MAC® D-Blade VL with a hyper-angled barrel was used as a rescue technique for those with failed intubation with DL. Further studies are needed to investigate the effects of VLs with different characteristics on airway management in a larger patient population from various regions, especially in UDA.

CONCLUSION

The present study showed that VL improved glottic visualization, reduced the risk of complications such as oropharyngeal injury and esophageal intubation, and increased the rate of successful endotracheal intubation compared to DL in patients with UDA. Therefore, our results support VL as a routine technique rather than as a rescue method for failed DL. It could significantly reduce the risk of adverse events in patients with UDA. However, we believe it should be confirmed in more patient groups and with different VL types.

Ethics Committee Approval: This retrospective study involving human participants was in accordance with the ethical standards of the institutional and national research committee

and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Approval was granted by the Ethics Committee of Tokat Gaziosmanpaşa University (April 8, 2025 / 25-MOBAEK-124).

Informed Consent: Due to the retrospective design of the study, the requirement for informed consent to participate was waived.

Data availability: The data used to support the findings of this study can be obtained from the corresponding author on request.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The authors have no relevant financial or non-financial interests to disclose.

Author Contributions: Conception: A.G; Design: A.G, H.T, T.K, S.K; Supervision: A.G, V.K, H.T, T.K, S.K; Materials: A.G, M.G.B, T.K; Data Collection and/or Processing: A.G, A.T.S, H.T; Analysis and/or Interpretation: A.G, A.T.S, M.G.B, T.K, S.K; Literature Review: A.G, V.K; Writing: A.G, A.T.S, M.G.B, V.K, H.T, T.K, S.K; Critical Review: A.T.S, M.G.B, V.K, H.T, T.K, S.K.

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