Comparative Study of Videolaryngoscopy and Direct Laryngoscopy for Training Airway Management Skills

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ABSTRACT

Background: Airway management is a critical skill in anaesthesia and emergency care that requires effective training methods to ensure patient safety. Direct laryngoscopy has traditionally been used; however, videolaryngoscopy has emerged as a promising alternative, offering improved visualization and potentially better learning outcomes than direct laryngoscopy. Despite its growing use, comparative evidence on trainee populations remains limited, particularly in resource-constrained settings. This study aimed to compare videolaryngoscopy and direct laryngoscopy for training in airway management skills among trainee doctors. **Methods & Materials:** A comparative observational study was conducted at the Department of Anaesthesia, Analgesia and Intensive Care Medicine, Bangladesh Medical University (BMU), from January to March 2026. A total of 60 trainees were equally divided into the videolaryngoscopy and direct laryngoscopy groups. Baseline characteristics, intubation performance, glottic visualization, ease of intubation and complications were analyzed. **Results:** The baseline characteristics were comparable between the groups. First-attempt success was significantly higher in the videolaryngoscopy group (86.7% vs. 63.3%, $p = 0.038$). The time to successful intubation was shorter (34.6 ± 8.9 vs. 48.2 ± 12.5 s, $p < 0.001$) and fewer attempts were required ($p = 0.011$). Videolaryngoscopy provided better glottic visualization, with higher Cormack-Lehane grade I/II views (93.3% vs. 66.7%, $p = 0.012$) and higher POGO scores ($p < 0.001$). The ease of intubation was also significantly greater. The complications were lower in the videolaryngoscopy group, but the difference was not statistically significant. **Conclusion:** Videolaryngoscopy enhances intubation performance, visualization and ease of use among trainees. Integrating it into training programs may improve airway management skills and patient safety.

Keywords: *Videolaryngoscopy, Direct laryngoscopy, Airway management, Intubation training, Glottic visualization.*

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INTRODUCTION

Airway management is a fundamental skill in anaesthesia and critical care practice, requiring both technical precision and clinical judgment. Endotracheal intubation remains the gold standard for securing the airway, particularly in emergency and perioperative settings. Traditionally, direct laryngoscopy has been widely used; however, it requires alignment of anatomical axes and significant operator experience, which may pose challenges for novice trainees [1].

In recent years, videolaryngoscopy has emerged as an important advancement in airway management. This technique provides an indirect view of the glottis through a camera, allowing improved visualization without requiring optimal alignment of airway structures. Several studies have demonstrated that videolaryngoscopy enhances glottic visualization and may improve intubation success rates, especially among less experienced operators [2,3].

Training in airway management is a critical component of medical education, particularly for anaesthesia trainees. Traditional teaching methods rely heavily on direct laryngoscopy, which may have a steep learning curve. In contrast, videolaryngoscopy offers real-time visual feedback, allowing instructors and trainees to simultaneously observe the airway anatomy during intubation attempts. This shared visualization has been shown to enhance learning and facilitate skill acquisition [4,5].

Despite these advantages, the debate regarding the optimal training modality remains ongoing. Some evidence suggests that initial training with videolaryngoscopy may improve first-attempt success rates and reduce complications [6,7]. Conversely, other studies emphasize the importance of mastering direct laryngoscopy as a foundational skill, arguing that reliance on videolaryngoscopy alone may limit adaptability in resource-limited settings [8].

Previous comparative studies have reported mixed findings regarding intubation performance outcomes. Muhamed et al. demonstrated improved performance with videolaryngoscopy among medical students in simulated scenarios [1]. Similarly, meta-analyses have shown higher success rates and better glottic views with videolaryngoscopy compared to direct laryngoscopy [9,10]. However, some randomized trials have reported no

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significant difference in overall success rates between the two techniques, highlighting the need for further investigation [11,12].
Complications associated with intubation, including esophageal intubation, dental trauma and hypoxia, are critical considerations during training. Evidence suggests that videolaryngoscopy may reduce the incidence of such complications by providing better visualization and guidance [13,14]. However, the extent of this benefit in trainee populations remains uncertain.
In the context of developing countries such as Bangladesh, where training resources and clinical exposure may vary, identifying the most effective teaching modality is particularly important. There is limited local evidence comparing videolaryngoscopy and direct laryngoscopy in training settings. Most existing studies have been conducted in high-resource environments, which may not fully reflect local training conditions.
Therefore, this study aims to compare videolaryngoscopy and direct laryngoscopy in terms of intubation performance, glottic visualization, ease of use and associated complications among trainees. By evaluating these parameters in a controlled training environment, the study seeks to provide evidence that may inform airway management training practices and improve clinical outcomes.

METHODS & MATERIALS

This comparative observational study was conducted in the Department of Anaesthesia, Analgesia and Intensive Care Medicine at Bangladesh Medical University (BMU), Dhaka, Bangladesh. The study period extended from January 2026 to March 2026. The study population consisted of trainee doctors undergoing airway management training. A total of 60 participants were included and equally divided into two groups: videolaryngoscopy (n = 30) and direct laryngoscopy (n = 30).

Selection Criteria:
Inclusion Criteria:

- Trainee doctors undergoing airway management training
- Participants with basic theoretical knowledge of intubation
- Individuals willing to participate in both techniques
- Trainees with limited prior intubation experience

Exclusion Criteria:

- Participants with advanced airway management expertise
- Incomplete data records
- Previous extensive hands-on experience with videolaryngoscopy

Data Collection Procedure

Data were collected retrospectively from structured training records and procedural logs maintained in the department. Participants were divided into two groups based on the technique used during training sessions. Standardized airway mannequins and simulation-based settings were utilized to ensure consistency across procedures. Each trainee performed intubation under supervision using either videolaryngoscopy or direct laryngoscopy.
Baseline characteristics, including age, gender, prior airway training, previous intubation attempts and dominant hand, were recorded before the procedure. During the training sessions, key performance indicators such as first-attempt success, overall success rate, time to successful intubation and number of attempts were documented using standardized assessment forms. Time measurements were recorded using digital timers to ensure accuracy.
Glottic visualization was assessed using the Cormack-Lehane grading system and Percentage of Glottic Opening (POGO) scores. Ease of intubation was evaluated using a visual analogue scale ranging from 1 to 10, based on the trainee's perception immediately after the procedure. Complications, including esophageal intubation, dental trauma, oxygen desaturation and airway injury, were documented by supervising clinicians.
To ensure reliability, all procedures were conducted under similar conditions and supervising faculty used uniform criteria for evaluation. Data were cross-checked for completeness and consistency before analysis. Participant confidentiality was strictly maintained by anonymizing all records and assigning unique identification codes. No personal identifiers were included in the dataset and access to data was restricted to the research team.

Statistical Analysis

Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation and compared using independent t-tests. Categorical variables were presented as frequencies and percentages and analyzed using chi-square or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table I presents the baseline characteristics of study participants. The mean age was comparable between videolaryngoscopy (25.8 ± 1.9 years) and direct laryngoscopy groups (26.1 ± 2.1 years), with no significant difference (p = 0.56). The proportion of male participants was similar in both groups (60.0% vs 56.7%, p = 0.79). Prior airway training was reported in 30.0% of the videolaryngoscopy group and 26.7% of the direct laryngoscopy group (p = 0.77). Median previous intubation attempts were comparable between groups. Most participants were right-hand dominant in both groups, with no statistically significant difference.

Table I
Baseline Characteristics of Study Participants (Trainees).

Variable	Videolaryngoscopy (n = 30)	Direct Laryngoscopy (n = 30)	p-value
Mean age (years), mean ± SD	25.8 ± 1.9	26.1 ± 2.1	0.56
Male, n (%)	18 (60.0)	17 (56.7)	0.79
Prior airway training (yes), n (%)	9 (30.0)	8 (26.7)	0.77
Previous intubation attempts (median, IQR)	3 (2–5)	3 (1–4)	0.68
Dominant hand (right), n (%)	27 (90.0)	26 (86.7)	0.69

Table II shows intubation performance outcomes. First-attempt success was higher in the videolaryngoscopy group (86.7%) compared to direct laryngoscopy (63.3%), showing statistical significance (p = 0.038). The overall success rate was higher with videolaryngoscopy (96.7%) than direct laryngoscopy (83.3%), although not statistically significant (p = 0.092). Mean time to successful intubation was shorter in the videolaryngoscopy group (34.6 ± 8.9 seconds) compared to the direct laryngoscopy group (48.2 ± 12.5 seconds), which was statistically significant (p < 0.001). The mean number of attempts was lower in the videolaryngoscopy group (1.2 ± 0.5 vs 1.6 ± 0.7, p = 0.011). Failed intubation occurred less frequently in the videolaryngoscopy group (3.3% vs 16.7%).

Table II
Intubation Performance Outcomes.

Outcome Variable	Videolaryngoscopy (n = 30)	Direct Laryngoscopy (n = 30)	p-value
First-attempt success, n (%)	26 (86.7)	19 (63.3)	0.038
Overall success rate, n (%)	29 (96.7)	25 (83.3)	0.086
Time to successful intubation (seconds), mean ± SD	34.6 ± 8.9	48.2 ± 12.5	<0.001
Number of attempts, mean ± SD	1.2 ± 0.5	1.6 ± 0.7	0.011
Failed intubation, n (%)	1 (3.3)	5 (16.7)	0.086

Table III describes glottic visualization and ease of intubation. A higher proportion of participants achieved Cormack-Lehane Grade I/II in the videolaryngoscopy group (93.3%) compared to direct laryngoscopy (66.7%), with statistical significance (p = 0.012). Grade III/IV views were more common in the direct laryngoscopy group. The mean POGO score was significantly higher in the videolaryngoscopy group (82.5 ± 10.4) than in the direct laryngoscopy group (58.7 ± 15.2, p < 0.001). Ease of intubation scores were also higher in the videolaryngoscopy group (8.6 ± 1.1 vs 6.3 ± 1.7, p < 0.001).

Table III
Glottic Visualization and Ease of Intubation.

Parameter	Videolaryngoscopy (n = 30)	Direct Laryngoscopy (n = 30)	p-value
Cormack-Lehane Grade I/II, n (%)	28 (93.3)	20 (66.7)	0.01
Cormack-Lehane Grade III/IV, n (%)	2 (6.7)	10 (33.3)	0.01
POGO score (%), mean ± SD	82.5 ± 10.4	58.7 ± 15.2	<0.001
Ease of intubation (VAS 1–10), mean ± SD	8.6 ± 1.1	6.3 ± 1.7	<0.001

Table IV presents complications and adverse events. Esophageal intubation was observed only in the direct laryngoscopy group (10.0%). Dental trauma occurred more frequently in the direct laryngoscopy group (13.3%) compared to videolaryngoscopy (3.3%). Oxygen desaturation was higher in the direct laryngoscopy group (20.0% vs 6.7%). Airway trauma was also more frequent in the direct laryngoscopy group (16.7% vs 3.3%). However, none of these differences reached statistical significance.

Table IV
Complications and Adverse Events.

Complication	Videolaryngoscopy n (%)	Direct Laryngoscopy n (%)	p-value
Esophageal intubation	0 (0.0)	3 (10.0)	0.078
Dental trauma	1 (3.3)	4 (13.3)	0.163
Oxygen desaturation (<90%)	2 (6.7)	6 (20.0)	0.133
Airway trauma (minor bleeding)	1 (3.3)	5 (16.7)	0.086

DISCUSSION

The present study demonstrates that videolaryngoscopy significantly improves intubation performance, glottic visualization and ease of intubation compared to direct laryngoscopy among trainee doctors. These findings are consistent with a growing body of evidence supporting the educational and clinical advantages of videolaryngoscopy, particularly for novice operators.

In this study, first-attempt success was significantly higher in the videolaryngoscopy group (86.7%) compared to the direct laryngoscopy group (63.3%). This aligns with findings from Muhamed et al., who reported improved first-pass success among medical students using videolaryngoscopy in simulated settings [1]. Similarly, Moussa et al. observed enhanced first-attempt success in neonatal intensive care settings with videolaryngoscopy [15]. The improved success rate may be attributed to better visualization of the glottis, which reduces uncertainty during tube placement.

Although the overall success rate was higher in the videolaryngoscopy group, the difference was not statistically significant. This finding is consistent with Klabusayová et al., who reported comparable overall success rates between the two techniques despite improved visualization with videolaryngoscopy [11]. It suggests that while videolaryngoscopy facilitates early success, trainees may eventually achieve successful intubation with either method after multiple attempts.

Time to successful intubation was significantly shorter in the videolaryngoscopy group in the present study. This observation is supported by Hu et al., whose meta-analysis demonstrated reduced intubation time with videolaryngoscopy in pediatric populations [9]. Faster intubation is clinically relevant, as prolonged attempts are associated with increased risk of hypoxia and other complications. The reduced number of attempts observed in this study further supports the efficiency of videolaryngoscopy as a training tool.

Glottic visualization was markedly superior in the videolaryngoscopy group, with a significantly higher proportion of Cormack-Lehane Grade I/II views and higher POGO scores. These findings are consistent with Choudhary et al., who reported improved glottic visualization with videolaryngoscopy in patients with limited airway views [16]. Similarly, Hoshijima et al. found that videolaryngoscopy significantly enhances the laryngeal view compared to direct laryngoscopy [13]. Improved visualization is a key factor contributing to higher success rates and reduced complications.

Ease of intubation, as measured by VAS score, was significantly higher in the videolaryngoscopy group. This finding is supported by Rajan et al., who demonstrated that videolaryngoscopy provides a more favorable intubation experience for operators [14]. The shared

visual field between instructor and trainee may also facilitate immediate feedback, enhancing skill acquisition and confidence.
Regarding complications, the present study observed lower rates of esophageal intubation, dental trauma, oxygen desaturation and airway injury in the videolaryngoscopy group, although these differences were not statistically significant. These trends are consistent with findings from Hajiyeva et al., who reported fewer complications with videolaryngoscopy in pediatric patients [6]. Similarly, Prekker et al. demonstrated reduced adverse events with videolaryngoscopy in critically ill adults [17]. The improved visualization likely contributes to safer intubation by minimizing blind attempts and reducing mechanical trauma.
The role of videolaryngoscopy as a teaching tool has been emphasized in several studies. O'Shea et al. showed that videolaryngoscopy significantly improves training outcomes in neonatal intubation [18]. Johnston et al. also reported enhanced learning efficiency when videolaryngoscopy was incorporated into simulation-based training [19]. These findings support the use of videolaryngoscopy in structured training programs, particularly for novice learners.
Despite these advantages, direct laryngoscopy remains an essential skill. Hsu et al. emphasized the importance of maintaining proficiency in direct techniques, particularly in settings where videolaryngoscopy may not be available [8]. Therefore, an integrated training approach that includes both techniques may be optimal.
The findings of this study are particularly relevant in the context of resource-limited settings. While videolaryngoscopy offers clear advantages, its availability may be constrained. However, incorporating videolaryngoscopy into training programs may accelerate skill acquisition and improve patient safety, even if direct laryngoscopy remains the primary clinical tool.
Overall, the present study supports the growing consensus that videolaryngoscopy enhances intubation training by improving visualization, efficiency and success rates. These findings contribute to the ongoing debate regarding the optimal approach to airway management training and highlight the potential benefits of integrating videolaryngoscopy into standard teaching practices.

LIMITATIONS
The study was limited by its small sample size and single-center design. Simulation-based settings may not fully reflect real clinical conditions. Future multicenter studies with larger samples and clinical validation are recommended to strengthen generalizability.

CONCLUSION
Videolaryngoscopy significantly improves first-attempt success, reduces intubation time and enhances glottic visualization compared to direct laryngoscopy among trainees. It also provides greater ease of intubation and shows a trend toward fewer complications. These findings support the incorporation of videolaryngoscopy into airway management training programs to improve skill acquisition and procedural efficiency. However, maintaining competency in direct laryngoscopy remains essential for comprehensive clinical preparedness.

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CONFLICTS OF INTEREST
There are no conflicts of interest.

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