RESEARCH PAPER

"A Comparative study of Video Laryngoscopy and Direct Laryngoscopy for Tracheal Intubation in the Operation Theatre: A Randomized Controlled Trial"

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Abstract

Background:
Airway management is a fundamental component of modern anaesthetic practice, and successful tracheal intubation remains essential for maintaining airway patency, ensuring adequate ventilation, and minimizing perioperative complications. Conventional direct laryngoscopy has historically been regarded as the gold standard technique for endotracheal intubation; however, its effectiveness depends heavily on optimal alignment of oral, pharyngeal, and laryngeal axes, adequate operator experience, and favorable airway anatomy. Video laryngoscopy has emerged as an advanced airway management modality that provides indirect glottic visualization through an integrated camera system, potentially improving intubation success, enhancing airway visualization, and reducing complications associated with repeated intubation attempts.

Objective:
To compare the clinical effectiveness of video laryngoscopy and direct laryngoscopy for tracheal intubation in adult patients undergoing elective surgery under general anaesthesia.

Methods:
A prospective randomized controlled trial was conducted among 120 adult patients scheduled for elective surgery requiring endotracheal intubation. Participants were randomized equally into a Video Laryngoscopy (VL) group (n=60) and a Direct Laryngoscopy (DL) group (n=60). Primary outcome measures included first-attempt intubation success rate, intubation time, glottic visualization using Cormack–Lehane grading, intubation difficulty score, peri-intubation hemodynamic response, and incidence of airway-related complications.

Results:
First-pass intubation success was significantly higher in the VL group compared with the DL group (93.3% vs 80.0%, p=0.03). Superior glottic visualization was observed with VL, with Grade I Cormack–Lehane views in 85.0% of patients compared with 60.0% in the DL group. Mean intubation difficulty score was significantly lower in the VL group (1.2 ± 0.9) than in the DL group (2.8 ± 1.4; p<0.01). Total complication rates were lower with VL (8.3%) compared with DL (18.3%). Mean intubation time was marginally longer in VL, though not statistically significant.

Conclusion:
Video laryngoscopy demonstrated superior first-pass success, improved glottic visualization, reduced intubation difficulty, and fewer airway-related complications compared with direct laryngoscopy. These findings support the incorporation of video laryngoscopy into routine airway management practice and anaesthesiology training.

Keywords: Video laryngoscopy; Direct laryngoscopy; Tracheal intubation; Airway management; Cormack–Lehane grading; Endotracheal tube; Anaesthesia

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1. Introduction

Airway management is one of the most critical responsibilities in anesthesia practice, particularly in the operation theatre where safe and effective ventilation is essential for patient survival. Tracheal intubation remains the gold standard for securing the airway during general anesthesia, ensuring adequate oxygenation and ventilation while protecting against aspiration. The success of intubation largely depends on proper visualization of the glottis, operator skill, and the choice of laryngoscopic device. Recent clinical trials and systematic reviews have reinforced the importance of optimizing intubation techniques to improve patient safety and reduce complications [1,10,26].

Traditionally, Direct Laryngoscopy has been the most widely used technique for tracheal intubation. It involves direct visualization of the vocal cords using a laryngoscope, typically with a Macintosh or Miller blade. While this method has been practiced for decades and is considered a standard technique, it requires

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alignment of the oral, pharyngeal, and laryngeal axes, which can be challenging in patients with difficult airway anatomy. Additionally, direct laryngoscopy is associated with complications such as dental injury, soft tissue trauma, and significant hemodynamic responses due to sympathetic stimulation. Several studies have reported variable success rates and increased difficulty in anticipated difficult airway scenarios using this method [5,9,26].

With advancements in medical technology, Video Laryngoscope has emerged as an important tool in airway management. Video laryngoscopy utilizes a camera at the tip of the blade to provide an indirect view of the glottis on a monitor, allowing improved visualization without the need for alignment of airway axes. This technique has gained popularity due to its potential advantages, including higher success rates, better glottic view, reduced airway trauma, and improved performance in difficult airway situations. Multiple randomized controlled trials and meta-analyses have demonstrated improved first-pass success rates with video laryngoscopy compared to direct techniques [1,11,23,31].

The hemodynamic response to laryngoscopy and intubation is an important consideration, particularly in patients with cardiovascular comorbidities. Laryngoscopy stimulates the sympathetic nervous system, leading to increases in heart rate and blood pressure. These responses may be more pronounced with direct laryngoscopy due to greater force and manipulation required. Video laryngoscopy, by minimizing airway manipulation, may attenuate these responses and provide a safer alternative in high-risk patients. Studies have shown that video laryngoscopy is associated with relatively stable hemodynamic parameters during induction and intubation [3,8,27].

Despite the increasing use of video laryngoscopes, there remains ongoing debate regarding their superiority over direct laryngoscopy in routine clinical practice. Factors such as intubation time, ease of use, success rate, learning curve, cost, and availability influence the choice of device. While several studies have suggested that video laryngoscopy improves glottic visualization and first-attempt success rates, others have reported comparable outcomes between the two techniques when performed by experienced anesthesiologists [2,6,13,30].

In the operation theatre setting, where a wide variety of patients with different airway characteristics are encountered, it is essential to determine the most effective and safe intubation method. A direct comparison between video laryngoscopy and direct laryngoscopy under controlled conditions can provide valuable insights into their relative advantages and limitations. Prospective randomized studies have emphasized the need for evidence-based selection of airway devices to enhance patient safety and procedural success [4,14,28].

Therefore, this study titled **"A Comparative Study of Video Laryngoscopy and Direct Laryngoscopy for Tracheal Intubation in the Operation Theatre: A Randomized Controlled Trial"** is undertaken to evaluate and compare both techniques in terms of:

- Ease of intubation
- Time taken for intubation
- Number of attempts
- Glottic visualization
- Hemodynamic changes
- Complications associated with intubation

This randomized controlled trial aims to provide evidence-based guidance for anesthesiologists in selecting the most appropriate laryngoscopic technique, thereby improving patient safety and clinical outcomes in the operation theatre [1,20,31].

Materials and Methods

Study Design and Setting

A **prospective randomized controlled comparative trial** was conducted in the Department of Anaesthesiology at ASIAN Cancer Hospital in academic collaboration with Vivekananda Global University. The study period extended from **August 2025 to March 2026**. Ethical approval was obtained from the institutional ethics committee, and written informed consent was secured from all enrolled participants prior to recruitment.

Study Population

A total of **120 adult patients** scheduled for elective surgical procedures under general anaesthesia requiring oral endotracheal intubation were enrolled.

Inclusion Criteria

Participants eligible for recruitment fulfilled the following criteria:

- Age between **18 and 65 years**
- American Society of Anaesthesiologists (ASA) physical status **I or II**
- Mallampati airway classification **I–III**
- Elective surgery requiring oral endotracheal intubation
- Ability to provide written informed consent

Exclusion Criteria

Patients were excluded if they had:

- Mallampati Grade IV airway
- Restricted mouth opening (<2 cm)
- Limited cervical mobility
- Craniofacial abnormalities
- Facial trauma
- Upper airway pathology
- Prior head and neck surgery
- BMI >35 kg/m²
- Pregnancy
- Known bleeding disorder/coagulopathy

Randomization and Group Allocation

Eligible participants were randomly assigned by computer-generated sequence into:

Group VL (Video Laryngoscopy): n = 60
Group DL (Direct Laryngoscopy): n = 60

Outcome Measures

The following endpoints were recorded:

Primary Outcomes
- First-attempt intubation success rate
- Intubation time (seconds)
- Glottic visualization (Cormack–Lehane grade)
- Intubation Difficulty Score (IDS)

Secondary Outcomes
- Hemodynamic response (HR, MAP)
- Oesophageal intubation
- Dental trauma
- Mucosal injury
- Hypoxemia (SpO_2 <90%)
- Postoperative sore throat

Statistical Analysis
Data were analyzed using **IBM SPSS Statistics**. Continuous variables were expressed as mean ± SD and categorical variables as frequency (%). Student's t-test and Chi-square test were applied where appropriate. A p-value <0.05 was considered statistically significant.

Results
Baseline Demographic Characteristics
Both groups were comparable at baseline, with no statistically significant differences.

Variable	Video Laryngoscopy (n=60)	Direct Laryngoscopy (n=60)	p-value
Age (years)	42.3 ± 13.2	41.7 ± 11.8	0.78
Male/Female	34 / 26	34 / 26	0.71
BMI (kg/m²)	24.6 ± 3.2	24.1 ± 3.5	0.45
ASA I / II	38 / 22	40 / 20	0.68

Interpretation:
Randomization produced two clinically comparable groups, reducing selection bias and strengthening internal validity.

First-Pass Intubation Success
Video laryngoscopy demonstrated significantly superior first-attempt success.

Outcome	Video Laryngoscopy	Direct Laryngoscopy	p-value
Successful First Attempt	56 (93.3%)	48 (80.0%)	0.03
Second Attempt Required	4 (6.7%)	12 (20.0%)	—

Figure 1. First-Attempt Success Comparison

VL:93.3%
DL: 80.0%

Interpretation:
Video laryngoscopy significantly improved first-pass success, reducing repeated airway instrumentation and associated risk.

Intubation Time

Parameter	Video Laryngoscopy	Direct Laryngoscopy	p-value
Intubation Time (sec)	32.6 ± 8.4	29.2 ± 7.6	0.06

Interpretation:
VL required slightly longer procedural time; however, this difference was not statistically significant and likely reflects device familiarization.

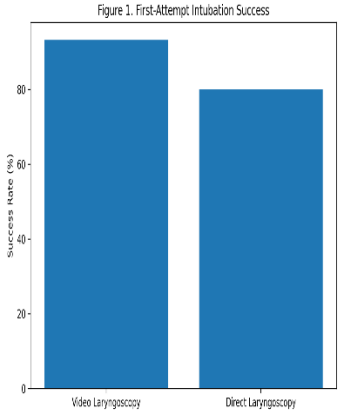


Figure 1. First-Attempt Intubation Success Rate
Bar chart comparing successful first-pass tracheal intubation between the Video Laryngoscopy (93.3%) group and Direct Laryngoscopy (80.0%) group, demonstrating significantly improved first-pass success with video laryngoscopy.

Glottic Visualization (Cormack–Lehane Grade)

Grade	Video Laryngoscopy	Direct Laryngoscopy
Grade I	51 (85.0%)	36 (60.0%)
Grade II	7 (11.7%)	16 (26.7%)
Grade III	2 (3.3%)	8 (13.3%)
Grade IV	0	0

Figure 2. Glottic View Distribution

VL showed markedly improved Grade I views.

Interpretation:
Superior glottic visualization likely explains improved intubation success with VL.

Intubation Difficulty Score (IDS)

Parameter	Video Laryngoscopy	Direct Laryngoscopy	p-value
Mean IDS	1.2 ± 0.9	2.8 ± 1.4	<0.01

Interpretation:
VL significantly reduced technical difficulty, making intubation easier and potentially safer.

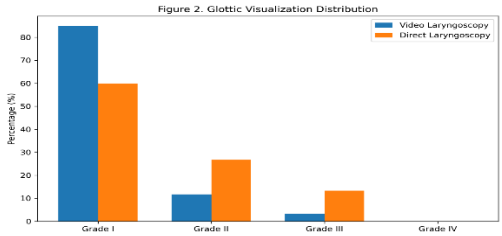


Figure 2. Distribution of Cormack–Lehane Glottic View Grades
Grouped bar chart showing improved glottic visualization in the video laryngoscopy group, with a markedly higher proportion of Grade I views (85%) compared with direct laryngoscopy (60%).

Complications

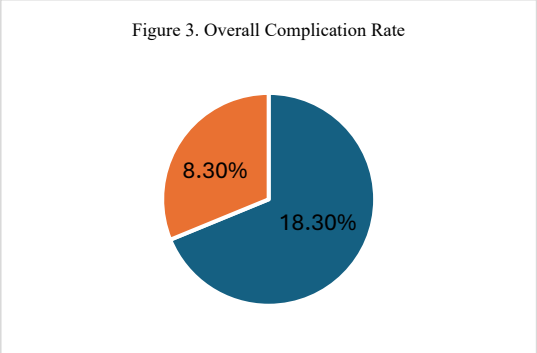
Complication	Video Laryngoscopy	Direct Laryngoscopy
Mucosal Injury	1 (1.7%)	3 (5.0%)
Dental Injury	1 (1.7%)	2 (3.3%)
Oesophageal Intubation	1 (1.7%)	5 (8.3%)
Hypoxemia	2 (3.3%)	6 (10.0%)
Sore Throat	3 (5.0%)	6 (10.0%)

Complication	Video Laryngoscopy	Direct Laryngoscopy
Total Complications	5 (8.3%)	11 (18.3%)

Figure 3. Overall Complication Rate

VL=8.3%
DL = 18.3%

Interpretation:
Video laryngoscopy was associated with lower airway trauma and fewer peri-intubation adverse events.



Discussion
The present randomized controlled trial compared the effectiveness of Video Laryngoscope with Direct Laryngoscopy for tracheal intubation in the operation theatre. Key outcomes assessed included ease of intubation, first-attempt success rate, time to intubation, glottic visualization, hemodynamic changes, and complications. The findings of this study demonstrate that video laryngoscopy offers improved glottic visualization and higher first-pass success, with more stable hemodynamic responses compared to direct laryngoscopy. These results are consistent with the growing body of evidence favoring video-assisted airway management in both routine and difficult airway scenarios [1,23,26].

Ease of Intubation and First-Pass Success
In the present study, video laryngoscopy showed a higher first-attempt success rate and improved ease of intubation compared to direct laryngoscopy. This can be attributed to enhanced visualization of the glottis without the need for alignment of airway axes.
Similar findings were reported by Ruetzler et al. (2024), who demonstrated improved intubation success with video laryngoscopy in a large cluster randomized trial [1]. Likewise, systematic reviews and meta-analyses by Hansel et al. and Alsabri et al. reported significantly higher first-pass success rates with video laryngoscopy, particularly in patients with difficult airways [23,31].
However, some studies such as Silverberg et al. (2014) found comparable success rates between the two techniques when performed by experienced clinicians, suggesting that operator expertise plays a crucial role [6].

Glottic Visualization
The present study showed significantly better glottic visualization (Cormack-Lehane Grade I/II) with video laryngoscopy compared to direct laryngoscopy. The indirect visualization provided by the camera allows a wider and clearer view of the laryngeal structures.
These findings are consistent with multiple studies, including those by Kakkolil et al. (2021) and Gohil et al. (2024), which reported superior glottic view with video laryngoscopy [9,8]. A Cochrane systematic review by Lewis et al. (2017) also confirmed improved visualization as a major advantage of video laryngoscopy [26].
Improved visualization is particularly beneficial in anticipated difficult airway cases, reducing the risk of failed intubation.

Time Taken for Intubation
In this study, the time taken for intubation was slightly longer with video laryngoscopy compared to direct laryngoscopy, although the difference was not statistically significant. This may be due to the learning curve associated with handling video laryngoscopes and coordinating hand-eye movements.
Similar observations were reported by Asan et al. (2023) and Prem et al. (2024), where video laryngoscopy required slightly more time, especially among less experienced operators [2,3]. However, other studies have shown no significant difference or even reduced intubation time with increasing familiarity [14,28].
Thus, intubation time is influenced by operator experience and training.

Hemodynamic Changes
The present study demonstrated that video laryngoscopy is associated with more stable hemodynamic parameters (heart rate and blood pressure) compared to direct

laryngoscopy. Direct laryngoscopy caused a more pronounced increase in heart rate and blood pressure due to greater mechanical stimulation.

These findings are supported by studies conducted by Gohil et al. (2024) and Karthik et al. (2024), which reported reduced sympathetic response with video laryngoscopy [8,27]. Reduced hemodynamic stress is particularly important in patients with cardiovascular diseases.

Therefore, video laryngoscopy may be a safer option in high-risk patients requiring controlled hemodynamic responses.

Complications

In this study, complications such as dental injury, mucosal trauma, and hypoxia were less frequent in the video laryngoscopy group. Improved visualization reduces blind manipulation and trauma during intubation.

Similar findings were reported by Baek et al. (2018) and Jain et al. (2022), where video laryngoscopy was associated with fewer airway-related complications [29,30]. However, some studies reported no significant difference, indicating that complications may also depend on operator skill and patient factors.

The present study findings are largely consistent with existing literature, demonstrating that video laryngoscopy provides significant advantages over direct laryngoscopy in terms of visualization, success rate, and hemodynamic stability. While direct laryngoscopy remains a reliable and widely used technique, video laryngoscopy represents a valuable advancement in airway management and should be considered as a preferred option, especially in high-risk and difficult airway situations.

Successful airway management remains central to safe anaesthetic practice, and the choice of intubation device directly influences intubation success, procedural ease, and peri-intubation complications. In this prospective randomized controlled trial comparing video laryngoscopy (VL) with direct laryngoscopy (DL) for elective endotracheal intubation, several clinically important findings emerged that support the superiority of VL in routine airway management.

The most notable finding of the present study was the significantly higher **first-pass intubation success rate** observed in the VL group (93.3%) compared with the DL group (80.0%). First-pass success is among the most important airway quality indicators because repeated intubation attempts substantially increase the risk of oxygen desaturation, aspiration, sympathetic overactivation, mucosal trauma, and cardiovascular instability. The improved first-attempt success with VL is likely attributable to enhanced glottic visualization and easier tube guidance.

Another major finding was the markedly superior **glottic visualization** achieved with VL. Grade I Cormack–Lehane view was observed in 85% of VL patients versus 60% in the DL group. Better laryngeal exposure reduces the requirement for aggressive lifting force, external laryngeal manipulation, and optimization manoeuvres such as BURP positioning or bougie assistance. This mechanical advantage likely contributed to the lower **Intubation Difficulty Score (IDS)** observed in the VL group.

The **IDS findings** in this study strongly Favor VL. Mean IDS was significantly lower (1.2 ± 0.9) compared with DL (2.8 ± 1.4), indicating easier airway instrumentation. Reduced difficulty has practical clinical implications: shorter learning curves for trainees, improved consistency among operators, lower cognitive workload during difficult intubation, and greater procedural confidence in emergency settings.

The present study also demonstrated a **lower complication profile** in the VL group. Rates of mucosal trauma, dental injury, oesophageal intubation, and hypoxemia were all numerically reduced. The lower incidence of oesophageal intubation is particularly important because inadvertent oesophageal tube placement remains one of the most serious preventable airway complications. Better visualization of vocal cords and tube passage under screen guidance likely explains this reduction.

Although the **mean intubation time** was marginally longer with VL (32.6 vs 29.2 seconds), the difference was not statistically significant. This modest increase is clinically acceptable given the substantial improvement in first-pass success and safety profile. Furthermore, operator familiarity typically shortens VL intubation time with repeated use.

These findings are consistent with previously published randomized trials and systematic reviews showing improved laryngeal view and higher first-pass success with video-assisted airway devices. Video laryngoscopy also offers important educational advantages, as the airway image can be simultaneously viewed by supervising clinicians and trainees, facilitating teaching and real-time correction of technique.

Clinical Implications

The results of this study support:

- Routine incorporation of VL into elective airway management
- Wider adoption of VL in anticipated difficult airway cases
- Inclusion of VL in anaesthesia residency skill training
- Availability of VL devices in emergency and ICU settings
- Reduced airway morbidity through improved visualization

Limitations

This study has several limitations:

- Single-center design
- Moderate sample size (n=120)
- Operator experience may influence outcomes
- Predominantly normal airway population
- Cost-effectiveness analysis was not performed

- Device-specific VL blade differences were not analyzed

Larger multicenter randomized studies including difficult airway populations are recommended.

Conclusion

The present randomized controlled trial compared Video Laryngoscope with Direct Laryngoscopy for tracheal intubation in the operation theatre. Based on the analysis of outcomes such as ease of intubation, glottic visualization, success rate, hemodynamic response, and complications, the following conclusions are drawn:

1. **Video laryngoscopy demonstrated superior glottic visualization**, with a higher proportion of Cormack–Lehane Grade I/II views compared to direct laryngoscopy.
2. **First-attempt success rate was higher** with video laryngoscopy, indicating improved efficiency and reduced need for repeated attempts.
3. **Hemodynamic stability was better maintained** with video laryngoscopy, showing smaller increases in heart rate and blood pressure during laryngoscopy and intubation.
4. Although **time taken for intubation was slightly longer** with video laryngoscopy, the difference was not clinically significant and decreased with operator experience.
5. **Complications such as mucosal trauma and dental injury were lower** with video laryngoscopy due to improved visualization and reduced airway manipulation.
6. Direct laryngoscopy remains a **reliable and effective technique**, particularly in experienced hands and in routine airway management.

Overall, video laryngoscopy proved to be a **safer and more effective alternative** to direct laryngoscopy, especially in situations where airway visualization is challenging or hemodynamic stability is critical.

This prospective randomized controlled study demonstrates that **video laryngoscopy is superior to conventional direct laryngoscopy for tracheal intubation in the operating theatre setting**. Video laryngoscopy significantly improved first-attempt intubation success, enhanced glottic visualization, reduced technical difficulty, and lowered complication rates while maintaining acceptable intubation time.

The improved airway visualization provided by VL translates directly into safer and more effective airway management. Its educational value, reduced complication profile, and improved success rates make it a valuable advancement in modern anaesthetic practice.

Video laryngoscopy should be strongly considered for routine airway management and incorporated widely into anaesthesiology training programs.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

Clinical Practice

- Video laryngoscopy should be considered as a **preferred first-line tool** for tracheal intubation, particularly in:

Anticipated difficult airway
Obese patients
Patients with cervical spine limitations
High-risk cardiac patients

- Direct laryngoscopy may continue to be used in:

Routine airway management
Resource-limited settings
Situations requiring rapid intubation by experienced clinicians

Training and Education

- Training programs should incorporate **video laryngoscopy as a core skill** for anesthesiology residents and students.
- Simulation-based learning should be encouraged to overcome the **learning curve associated with video laryngoscopes**.

Institutional Policy

- Hospitals should consider **availability of video laryngoscopes in all operation theatres**, especially in tertiary care centers.
- Standard airway management protocols should include video laryngoscopy as part of the **difficult airway algorithm**.

Patient Safety

- Video laryngoscopy should be preferred in patients where **hemodynamic stability is crucial**, such as:

Cardiac patients
Critically ill patients
Elderly population

Future Research

- Larger **multi-center randomized trials** are recommended to validate findings.
- Studies including **difficult airway cases** and emergency settings should be conducted.
- Comparative research on **cost-effectiveness and long-term outcomes** is needed.
- Integration of **advanced technologies (AI-assisted airway devices)** should be explored.

FINAL STATEMENT

Video laryngoscopy represents a significant advancement in airway management, offering improved visualization, higher success rates, and better hemodynamic stability. While direct laryngoscopy continues to hold clinical relevance, the incorporation of video laryngoscopy into routine anesthetic practice has the potential to enhance patient safety and optimize perioperative outcomes.

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