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Original Research Article

Comparative Analysis of Video-Assisted and Conventional Direct Laryngoscopy

Pankaj Kumar[1], Ranjeet Kumar[2], Muni Lal Gupta[3], Dhananjay Kumar Suman[4]

[1]Senior Resident, Department of Anaesthesia and Critical Care Medicine, Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[2]Senior Resident, Department of Anaesthesia and Critical Care Medicine, Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[3]Associate Professor, Department of Anaesthesia and Critical Care Medicine, Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

[4]Associate Professor and HOD, Department of Anaesthesia and Critical Care Medicine, Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India

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Corresponding Author: Dr. Ranjeet Kumar

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Abstract:

Background: Airway management is fundamental to anesthetic practice, with laryngoscopy being central to successful tracheal intubation. Video laryngoscopy has emerged as an alternative to conventional direct laryngoscopy, potentially improving visualization and patient safety.

Aim: To compare video laryngoscopy and direct laryngoscopy with respect to glottic visualization and hemodynamic response during endotracheal intubation.

Methodology: This progressive, randomized comparative study enrolled 80 adult patients (ASA I–II) scheduled for elective surgery with general anesthesia. The patients were divided into two groups: video laryngoscopy (Group V, n=40) and direct laryngoscopy (Group D, n=40). Demographic data, airway parameters, Cormack–Lehane grades, and hemodynamic responses were recorded and analyzed.

Results: Both groups were comparable in demographic and baseline airway characteristics. Video laryngoscopy suggested enhanced glottic visualisation, resulting in a greater incidence of Cormack–Lehane Grade I views and a reduction in challenging views. It was additionally correlated with markedly reduced elevations in heart rate and meant arterial pressure relative to direct laryngoscopy ($p<0.05$).

Conclusion: Video laryngoscopy offers improved glottic visualization and better hemodynamic stability compared to direct laryngoscopy, supporting its role as an effective and safer airway management technique.

Keywords: Video laryngoscopy, Direct laryngoscopy, Airway management, Endotracheal intubation, Hemodynamic response.

Introduction

Airway management continues to be a fundamental activity in anesthesia, emergency medicine, and intensive care, where successful intubation of the trachea is a prerequisite for patients getting enough air and oxygen [1]. The most common way to perform endotracheal intubation is through laryngoscopy, a method that enables the doctor to see the entrance of the larynx so that the tube can be placed there easily. Intubation failure or difficulty often results in severe complications, such as hypoxia, aspiration, airway trauma, or even patient death [2]. Therefore, the continuous evaluation and refinement of laryngoscopic techniques and devices have remained pivotal in attaining the highest possible safety rates and surgical outcome.

Direct laryngoscopy, for many years, has been considered the gold standard method for intubation. Performing this with standard blades such as Macintosh or Miller laryngoscope, direct laryngoscopy requires a combination of the oral, pharyngeal, and laryngeal axes to have a direct view of the vocal cords [3]. Although it is highly effective with skilled practitioners, it is a demanding technique and very much dependent on the operator's skill. Anatomic differences, limited neck movement, obesity, jaw and face issues, and spine problems are factors that can greatly reduce the visibility of the glottis and thus result in a higher number of cases where the intubation is difficult or fails [4].

The advent of video laryngoscopy has been a tremendous breakthrough in the field of airway

management. These laryngoscopes have a miniature camera and light source at or very close to the blade tip, through which the glottis is continuously posted to a separate screen. The Glide Scope and C-MAC are examples of devices that offer indirect visualization of the laryngeal structures without the necessity of positional anatomical alignment [5]. The advantages mentioned have increased the clinicians' capacity to deal with both routine and difficult cases, and these devices have gradually become common in operating rooms, emergency departments, and intensive care units.

Among the various benefits that come with video laryngoscopy, the improved view of the glottis compared to direct laryngoscopy is the most notable one and it is usually manifested by better Cormack–Lehane grades. The improvement in visualization could directly lead to higher first-attempt success rates, fewer optimization maneuvers, and lighter force applied in the laryngoscopy process thus airway trauma may be reduced [6]. Also, the shared screen view gives the opportunity for the supervisors to guide the trainees in real time thus making video laryngoscopy an excellent educational tool in the process of teaching airway management skills.

However, video laryngoscopy still has some drawbacks notwithstanding these advantages. The intubation process still needs good and proper hand–eye coordination, the familiarity of the specific device's blade geometry, and sometimes the use of rigid stylets [7]. Some of the challenges reported include the difficulty in advancing the endotracheal tube despite the presence of a good glottic view, fogging or contamination of the camera lens, and the higher cost of the equipment. On the other hand, direct laryngoscopy is less expensive, more accessible, and does not depend on electronic components hence it is very useful in places where the resources are limited [8].

Contemporary anaesthetic practice still sees the debate about the implementation of video laryngoscopy in a routine or selective manner. On one hand, some practitioner's regard video laryngoscopy as the main technique of intubation for all patients, while others apply it exclusively to tough airways, whether those are predicted or not [9]. Still the same clinical issues of intubation success rates, time to intubation, hemodynamic changes, airway complications, and learning curves continue to play a crucial role in the comparison of the two methods.

Under such circumstances, one cannot avoid a systematic parallel between video laryngoscopy and direct laryngoscopy to determine the direction of airways through the evidence-based practice. The comprehension of different techniques' relative merits, their drawbacks, and their clinical applicability will facilitate clinicians to choose the right device for the specific patient, while at the same time assisting with the development of training methods that lead to safe patient handling in various clinical situations.

Methodology

Study Design: This study was structured as a prospective, randomized, comparative clinical trial to assess and compare the efficacy and performance of video laryngoscopy against direct laryngoscopy for tracheal intubation in adult surgical patients receiving general anaesthesia.

Study Area: The research was carried out in the Department of Anaesthesia and Critical Care Medicine at Bhagwan Mahavir Institute of Medical Sciences (BMIMS), Pawapuri, Nalanda, Bihar, India.

Study Duration: The duration of the study was six months, from April 2025 to September 2025.

Study Participants

Inclusion Criteria

- Adult patients between the ages of 18 and 60 years
- Both male and female patients
- American Society of Anesthesiologists (ASA) physical status I and II
- Patients scheduled for elective surgical operations involving general anaesthesia and endotracheal intubation.
- Patients who submitted written informed consent

Exclusion Criteria

- Patients with anticipated difficult airway (Mallampati grade III or IV)
- Restricted mouth opening (<3 cm)
- Cervical spine instability or trauma
- Upper airway pathology or deformity
- Emergency surgeries
- Patients at risk of aspiration or with gastroesophageal reflux disease

Sample Size: The study included a total of 80 patients. The patients were randomly assigned to two equal groups of 40 individuals each:

Group V: Intubation performed using video laryngoscopy

Group D: Intubation performed using direct laryngoscopy

Procedure: After attaining informed consent, patients were randomly allocated to either Group V or Group D utilizing a computer-generated randomization table. A standard pre-anesthetic assessment was conducted for all patients. Upon entering the operating theatre, standard monitoring protocols were initiated, encompassing electrocardiography, non-invasive blood pressure measurement, pulse oximetry, and end-tidal carbon dioxide assessment. Patients administered 100% oxygen for three minutes for

preoxygenation. General anesthesia was induced using standard intravenous agents, followed by administration of a neuromuscular blocking drug to facilitate tracheal intubation. Laryngoscopy and intubation were performed according to the assigned group by an anesthesiologist experienced with both devices. Parameters such as time to intubation, number of attempts, Cormack–Lehane grade, need for external laryngeal manipulation, and hemodynamic responses were recorded. Any complications such as desaturation, esophageal intubation, or dental trauma were noted.

Statistical Analysis: Data was inputted and analyzed via suitable statistical tools. Continuous variables were presented as mean ± standard deviation and analyzed using the student's t-test. Categorical variables were represented as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test where applicable. A p-value below 0.05 was deemed statistically significant.

Result

Table 1 shows that the patient demographic characteristics between the video laryngoscopy and direct laryngoscopy groups were similar. The average age of the subjects in both groups was very close (38.6 ± 10.2 years vs. 39.1 ± 9.8 years), so there was no significant difference between them at a statistical level. The gender distribution was comparable, featuring about equal numbers of males and females in each category. The mean body weight exhibited no significant difference between individuals undergoing video laryngoscopy and those undergoing direct laryngoscopy. The distribution of ASA physical status was similar, with patients I and II evenly represented in both groups. The absence of statistically significant differences ($p > 0.05$) among all measures confirmed that the groups were well matched demographically, hence minimizing confounding effects associated with their baseline characteristics.

Table 1: Demographic Characteristics of Patients

Parameter	Video Laryngoscopy (n=40)	Direct Laryngoscopy (n=40)	p-value
Age mean (years)	38.6 ± 10.2	39.1 ± 9.8	>0.05
Gender (Male/Female)	22 / 18	24 / 16	>0.05
Mean weight (kg)	62.4 ± 8.6	63.1 ± 9.1	>0.05
ASA I/II	26 / 14	25 / 15	>0.05

Table 2 presents a comparison of the baseline airway assessment parameters for the video laryngoscopy and direct laryngoscopy groups that were the same for both. Mallampati class I–II airways were mostly found in both groups as observed in 75% of the patients who had video laryngoscopy and 72.5% in the direct laryngoscopy group, and a similar but smaller part was classified as Mallampati III–IV. Potentially difficult airway signs like a thyromental distance of less than 6 cm and restricted neck movement appeared in both groups to the same degree with small differences that are not likely to be clinically significant. The airway characteristics were similar, which means that both groups were well matched at the beginning of the study, and thus, a fair comparison of the intubation outcomes for the two methods of laryngoscopy was possible.

Table 2: Airway Assessment Parameters

Airway Parameter	Video Laryngoscopy (n=40)	Direct Laryngoscopy (n=40)
Mallampati I–II	30 (75%)	29 (72.5%)
Mallampati III–IV	10 (25%)	11 (27.5%)
Thyromental distance < 6 cm	8 (20%)	9 (22.5%)
Limited neck movement	6 (15%)	7 (17.5%)

Table 3 illustrates the very distinct and discrepant glottic visualization between video and direct laryngoscopy and the Cormack–Lehane grading system was which was used as a measure. In video laryngoscopy, a significant increase in the number of Grade I views (65%) was noted when compared to laryngoscopy (40%), which shows that the superior laryngoscopy was achieved. On the contrary, the less frequent cases of poor views (Grade III and IV) were with video laryngoscopy (10% and 0%, respectively) compared to direct laryngoscopy (20% and 5%). As a matter of fact, the latter method displayed a higher incidence of intermediate and difficult views, with 35% Grade II and combined 25% Grade III–IV. In conclusion, such results indicate that the video technique not only allows better visualization of the glottis but also lowers the occurrence of difficult views during laryngoscopy when compared with the classic method.

Table 3: Cormack–Lehane Grading During Laryngoscopy		
Grade	**Video Laryngoscopy (n, %)**	**Direct Laryngoscopy (n, %)**
Grade I	26 (65%)	16 (40%)
Grade II	10 (25%)	14 (35%)
Grade III	4 (10%)	8 (20%)
Grade IV	0 (0%)	2 (5%)

Table 4 indicates that the intubation through video laryngoscopy has a distinctly lessened hemodynamic response when compared to direct laryngoscopy. The average heart rate increase was very small in the video laryngoscopy group (8.2 ± 3.4 beats/min) as opposed to the direct laryngoscopy group where it was (14.6 ± 4.8 beats/min), the difference being in favor of video laryngoscopy and the difference being statistically significant ($p < 0.05$). Likewise, the rise in mean arterial pressure was of statistical significance with video laryngoscopy (6.8 ± 2.9 mmHg) given direct laryngoscopy (12.1 ± 3.7 mmHg; $p < 0.05$) having a significantly higher mean pressure. These results suggest that video laryngoscopy is hemodynamically much more stable during intubation and this stability is achieved probably by reducing both airway manipulation and the resultant sympathetic stimulation.

Table 4: Hemodynamic Response to Intubation			
Parameter	**Video Laryngoscopy**	**Direct Laryngoscopy**	**p-value**
Rise in HR (beats/min)	8.2 ± 3.4	14.6 ± 4.8	<0.05
Rise in MAP (mmHg)	6.8 ± 2.9	12.1 ± 3.7	<0.05

Discussion

The research under discussion proves that it was methodologically sound to compare video laryngoscopy and direct laryngoscopy as both groups were nearly identical in terms of demographic as well as clinical baseline characteristics. The patients' age, gender, body weight and ASA physical status were all the same which made it very unlikely that the differences in intubation outcomes and hemodynamic responses were due to confounding patient-related factors. This demographic similarity increases the internal validity of the study and diminishes the role of baseline heterogeneity in the attribution of differences observed only to the laryngoscopy method. Sun et al., (2005) [10] determined that the additional 12 seconds for intubation holds little clinical importance, particularly in patients maintaining oxygen saturation above 90% during the procedure.

The parameters for baseline airway assessment were also similar for the two groups with a distribution of Mallampati classes, thyromental distance, and neck mobility that was alike. The presence of class I–II Mallampati airways among the participants of both groups indicates that most of them had relatively good airway anatomy. The equal proportion of the potentially difficult airway predictors in both groups is a point that secures the fact that both techniques were put to the test in the same airway conditions. This provides grounds for a just and unprejudiced assessment of the glottic visualization and intubation outcomes. Ambrosio et al., (2014) [11] reported that research on the usage of video laryngoscopy by first-year resident physicians in the management of difficult intubation. The anaesthetists demonstrated a significant improvement in their proficiency with the video laryngoscope compared to the direct laryngoscope following a training session that included both instruments.

One of the pivotal points in this research is the remarkable glottic visualization that was accomplished with video laryngoscopy, and which was rated through the Cormack–Lehane grading system. In the case of video laryngoscopy, the proportion of views rated as Grade I was much higher, while the incidence of views rated as Grade III–IV was much lower when compared to direct laryngoscopy. A lot of professional validation has been given to enhanced glottis visualization as an advantage of using video laryngoscopes since the camera as the blade tip renders indirect viewing possible without the stressful alignment of the oral, pharyngeal and laryngeal axes. The very clearness that comes with the use of video tools is crucial in reducing the difficulty of the intubation process and may result in getting the first-pass success rates higher. Ibinson et al., (2014) suggested a 93.6% success rate for one-time intubation using a video laryngoscope, indicating that the success rate in the video laryngoscope group (96.1%) surpassed that of the direct laryngoscope group with a senior anaesthetist (90.1%).

Direct laryngoscopy on the other hand, displayed a greater percentage of intermediate and poor laryngeal views indicating that the technique's reliance on optimum patient positioning and operator skill is its inherent weakness. The high occurrence of Grade III and IV views associated with direct laryngoscopy reflects the technique's potential limitations even in cases where there are no overt indicators of difficult airway. The observations made are a strong argument for video laryngoscopy as a primary airway management tool in such scenarios where safety depends on good visualization. Lewis et al., (2016) [13] concluded the significance of visual intubation

equipment in enhancing the success rate of intubating challenging airways. Nevertheless, they did not do a comprehensive analysis to demonstrate the disparities in intubation success rates and postoperative problems associated with the three distinct devices used for tracheal intubation in non-difficult airways.

The hemodynamic response to laryngoscopy and intubation is another significant result of the study. Video laryngoscopy was linked to significantly lesser raises in heart rate and mean arterial pressure in comparison to direct laryngoscopy. This reduced sympathetic response can be explained by the fact that during laryngoscopy there is less force and manipulation, as better seeing reduces the need for heavy lifting and airway stimulation. The stability of hemodynamics during intubation is relevant from a clinical point of view, especially in patients with cardiovascular or cerebrovascular comorbidities. According to Cooper et al. (2005) [14], 728 Glide Scope laryngoscopies were performed in operating rooms. Glide Scope facilitated C&L grade 1 or 2 views in 99% of patients.

In sum, the study's findings suggest that video laryngoscopy provides significant benefits over direct laryngoscopy in terms of glottic visualization and hemodynamic stability, not being influenced by demographic or pre-existing airway differences. These findings confirm the current literature and assert video laryngoscopy's position as a safer and more efficient alternative for endotracheal intubation. Larger future studies with wider patient selection including those with difficult airways anticipated may further enlarge the understanding of its benefits in different clinical settings.

Conclusion

To sum up, this prospective randomized study has in fact established that video laryngoscopy presents considerable advantages when compared to direct laryngoscopy in adults who share similar demographic and airway characteristics. The glottic visualization achieved with video laryngoscopy was much better, with the occurrence of favorable Cormack–Lehane grades being much higher and the incidence of difficult views being much lower. It also resulted in a markedly diminished haemodynamic response, as indicated by reduced fluctuations in heart rate and mean arterial pressure during intubation. These advantages are most likely due to the factors of getting better view and manipulating the airway less. Although direct laryngoscopy is still a trustworthy and commonly accessible method, the outcomes are in favor of the coming role of video laryngoscopy as a safer and more efficacious choice for airway management, which would not only be the case for everyday practice but would also have positive implications in terms of patient safety and training effectiveness.

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