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Success Rate Between Video Laryngoscopy and Conventional Laryngoscopy in Patients with Modified Mallampati classification III and IV

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Abstract: Background: Hard-to-manage airways are a significant cause of morbidity in anesthesia especially among patients with high Modified Mallampati. Video laryngoscopy has been suggested as the method that enhances glottic visualization and intubation success in comparison to the traditional direct laryngoscopy, and particularly in the airways that are predicted to be difficult. **Aim:** To compare the efficacy and safety of video laryngoscopy versus conventional laryngoscopy in patients with Modified Mallampati class III and IV undergoing elective surgery. **Methods:** The randomized controlled trial was carried out in the Department of Anesthesiology at Sheikh Zaid Hospital, Lahore between April and September 2025. Patients aged 1560 years with ASA physical status III and Mallampati III or IV received video laryngoscopy treatment (n= 45) or conventional laryngoscopy (n= 45). The key outcome measures were first attempt intubation success and Cormack-Lehane grade and the secondary outcomes measures intubation time, number of attempts, optimization of surgical interventions, and adverse events. Independent t-tests and chi-square tests were used to analyze data with the $p \leq 0.05$ value being considered statistically significant. **Results:** The attempt at first-attempt intubation was significantly greater in video laryngoscopy (93.3%) than in conventional laryngoscopy (68.9%, $p = 0.004$). The video group had favorable Cormack-Lehane grades I-II in 88.9% per cent as compared to 57.8% in the conventional group ($p < 0.001$). Video laryngoscopy took a shorter period than conventional laryngoscopy in terms of mean intubation time (24.8 ± 6.2 seconds versus 38.5 ± 9.4 seconds, $p < 0.001$). The number of adverse events, such as desaturation, airway trauma, esophageal intubation, and hemodynamic instability, were much lower in the video laryngoscopy group. **Conclusion:** Video laryngoscopy offers better intubation success, better visualization of the glottis, better procedure efficiency, and less complication than traditional laryngoscopy in patients with difficult airways as expected. The standardization of its application in Mallampati class III and IV patients could improve the safety of the airways and the clinical outcome.

Keywords: Video laryngoscopy, Conventional laryngoscopy, Difficult airway, Mallampati classification, Endotracheal intubation, Cormack–Lehane grading

INTRODUCTION

Airway management is one of the foundations of safe anesthetic practice and failed or challenging tracheal intubation is a significant cause of anesthesia morbidity and mortality globally (Weng et al., 2024).

The rate of challenging laryngoscopy in the general surgery unit is said to be between 5% and 10% and intubation failure is reported to be 0.05-0.35% in elective cases (Malekshoar et al., 2025). One of the

most popular predictors of challenging laryngoscopy is the Modified Mallampati classification that is used mostly in the preoperative routine examination (Kim et al., 2020). An increased Mallampati index signifies less oropharyngeal space and changes in tongue-pharyngeal associations, which physically block direct visualization of the glottis in the conventional laryngoscopy (Zhang et al., 2023). Mallampati class III and IV patients have been repeatedly demonstrated to possess very high rates of poor glottic views and intubation difficulty relative to patients with classes I and II (Liu et al., 2019).

Video laryngoscopy is a major technological development as it involves incorporation of camera systems which enable indirect visualization of the glottis without necessarily having the alignment of the full anatomical axis (Simsek et al., 2022). In several studies, video laryngoscopes have shown better Cormack-Lehane glottic perspectives than traditional Macintosh laryngoscopy especially in patients with issue of challenging airways anticipated (Ruetzler et al., 2024). A huge meta-analysis was found to have better first-attempt intubation success rate and low incidence of esophageal intubation when video laryngoscopy was employed in high-risk airway populations (Kongsawaddee et al., 2024). Video laryngoscopy in patients with Mallampati class III and IV airways has been reported to have more success in intubation and less external laryngeal manipulation than direct laryngoscopy (Islam et al., 2023). Video laryngoscopy is believed to counter the mechanical constraints of macroglossia, limited mouth opening, and reduced mandibular space (Srinivas et al., 2022). Notwithstanding such benefits, video laryngoscopy can also be linked with the increased duration of intubation during the failure of an inexperienced physician, and may have a definite training prerequisite (Ruetzler et al., 2024).
Traditional direct laryngoscopy with the Macintosh blade is the most popular method of intubation in the world as it is simple, cheap, and is available in most countries (Liu et al., 2024). According to epidemiological data straining, hard laryngoscopy is experienced in up to 30% of patients with Mallampati class III and IV, and less than 5% of patients with lower classes (Ruetzler et al., 2024). Repeated or unsuccessful intubation with direct laryngoscopy is known to be linked to the risks of hypoxemia, airway trauma and hemodynamic instability (Cook et al., 2011). Video laryngoscopy has been suggested as one of the attempts to decrease these complications and enhance the glottic exposure and reduce the number of successive attempts (Goh et al., 2025). Video laryngoscopy has been found to be less traumatic to the airways and less damaging to the teeth in the challenging airway situations, but not as universally effective (Lewis et al., 2016). The variability in the design of the devices, experience of the operators and population of the patients is the source of the current controversy on the routine use of video laryngoscopy versus selective usage (Araújo et al., 2024).

In Pakistan, challenging situations in airway management are exacerbated by high surgical cases, uneven availability of advanced airway equipment, and unequal anesthetic training among different healthcare facilities (Abbas et al., 2021). Local observational studies have shown that multiple intubation attempts and airway-related complications are found to be higher in low-income countries than in high-income countries, which highlights a patient safety issue of critical concern (Khan et al., 2023). The comorbidities of obesity, diabetes, and maxillofacial abnormalities are also common in Pakistan and further predispose the populations to the Mallampati class III and IV airways (Taqi et al., 2025). The comparative evaluation can inform the practice of anesthesia in the nation by determining whether video laryngoscopy has a clinically significant benefit over traditional methods in predicted difficult airways. Hence, this research aimed to compare the efficacy and safety of video laryngoscopy versus conventional laryngoscopy in Pakistani patients with Modified Mallampati class III and IV undergoing elective surgery.

Methods

Study Design and Setting

This was a randomized controlled trial study carried out in the Department of Anesthesiology in Sheikh Zaid Hospital, Lahore, between four months of April 2025, and September 2025. Research was intended to compare the usefulness of video laryngoscopy and traditional laryngoscopy in patients with expected difficult airway predicated on Modified Mallampati classification.

Sampling Technique and Sample Size

Participants were recruited through a non-probability consecutive method of sampling. The number of patients was 90 patients, 45 patients each in each of study groups. The sample size was determined on the basis of 95% confidence level and 80% study power given that the anticipated intubation success rate was 93% in the video laryngoscopy and 70.3% in the conventional laryngoscopy group. The patients taking part in the study were both male and female and of the age of 15 to 60 years and were to be put on elective surgeries which would involve endotracheal intubation under general anesthesia. Patients who were not categorized as American Society of Anesthesiologists physical status I or II and had a preoperative Modified Mallampati class III or IV were excluded. The patients who were excluded in the study were those with obesity, history of upper airway injury, trauma, or pathology, patients undergoing

emergency surgeries, and those who developed hemodynamic instability or airway complications during anesthesia induction.

Data Collection

Total of 90 patients were randomly assigned to two similar groups through the lottery system where Group A received tracheal intubation by video laryngoscopy as opposed to Group B who was intubated through conventional laryngoscopy. Patients in the operating theatre were in the supine position and preoxygenated over three to five minutes using 100% oxygen until end-tidal oxygen concentration at least 90%. Continuous monitoring of the heart rate, noninvasive blood pressure, oxygen saturation, electrocardiography, end-tidal carbon dioxide and temperature were monitored. A choice of induction agent was used and once satisfactory face-mask ventilation was ensured, a long-acting neuromuscular blocking agent was administered and anesthesia was supported by an inhalational agent. Tracheal intubation was done with assigned laryngoscope blade when there was adequate neuromuscular blockage. An attempt of intubation was considered to be the insertion of the laryngoscope blade into the mouth, insertion of the endotracheal tube, and the removal of the laryngoscope blade. Success rates in intubation were measured based on the operational definition and airway management was done based on the guidelines of the Difficult airway society. The laryngoscopy time in seconds was recorded by a different resident observer and commenced when the laryngoscope blade was obtaining written informed consent. inserted in the mouth of the patient until it was removed. When more than one attempt was needed, the time taken per attempt was added up to get the total time of laryngoscopy.

Data Analysis

All of the data collected were incorporated and analyzed by use of Statistical Package of the Social Sciences (SPSS) version 28. The quantitative variables like the age, the body mass index and the number of attempts to intubate were presented in terms of the mean and standard deviation. Qualitative data such as gender, ASA physical condition, success rate of intubation, and failure rate were in the form of frequencies and percentages. The chi-square test was used to compare success rates of intubation in the two groups. Potential modifying factors to the effects in the data included age, gender, body mass index, number of attempts, and ASA status and post-stratification chi-square testing was conducted. The p-value was taken as less than 0.05 as statistically significant.

Ethical Considerations

Prior approval was obtained from the Ethical Review Board of Shaikh Zayed Medical Complex, Lahore, before initiation of the study. All patients were enrolled from the surgical units after obtaining written informed consent.

Results

Demographic Profile

The video laryngoscopy group had a mean age of 38.6 ±11.2 versus the conventional laryngoscopy group of 39.4 ± 10.8 with no significant difference (p =.72). Among male patients, 57.8% were included in the video group and 53.3% in the conventional group (p = 0.67). In the same regard, the average values of BMI were similar at 26.1 ± 3.4 kg/m² and 26.5 ± 3.6 kg/m² respectively (p = 0.59). There was also similar distribution of ASA physical status with ASA I patients working 60% of the video laryngoscopy group and 55.6% of the conventional group.

Table 1: Demographic Characteristics of the Study Population (n = 90)

Variable	Video Laryngoscopy (n = 45)	Conventional Laryngoscopy (n = 45)	p-value
Age (years), Mean ± SD	38.6 ± 11.2	39.4 ± 10.8	0.72
Male Gender, n (%)	26 (57.8%)	24 (53.3%)	0.67
BMI (kg/m²), Mean ± SD	26.1 ± 3.4	26.5 ± 3.6	0.59
ASA I, n (%)	27 (60.0%)	25 (55.6%)	0.67
ASA II, n (%)	18 (40.0%)	20 (44.4%)	—

Baseline Clinical Characteristics

In the group of video laryngoscopy and conventional group, 68.9% and 66.7% respectively had Mallampati class III airways with class IV airways constituting 31.1% and 33.3% respectively. Neck extension was found to be restricted in only 24.4% of those patients that were subjected to video laryngoscopy as compared to 28.9% of the conventional group (p = 0.63). It was reduced to 20.0% and 22.2% of patients, respectively (p = 0.80).

Table 2: Baseline Airway Characteristics

Variable	Video Laryngoscopy (n = 45)	Conventional Laryngoscopy (n = 45)	p-value
Mallampati Class III, n (%)	31 (68.9%)	30 (66.7%)	0.82
Mallampati Class IV, n (%)	14 (31.1%)	15 (33.3%)	—
Limited Neck Extension, n (%)	11 (24.4%)	13 (28.9%)	0.63
Mouth Opening <3 cm, n (%)	9 (20.0%)	10 (22.2%)	0.80

Intubation Outcomes

In the video laryngoscopy group, it was found that favorable Cormack Lehane grades I-II were attained in 88.9% of patients as compared to only 57.8% in the conventional group ($p < 0.001$). Video laryngoscopy was significantly more successful on the first attempt at 93.3% and the conventional laryngoscopy was successful at 68.9% ($p = 0.004$). It was established that the mean intubation time in the video group (24.8 ± 6.2 seconds) was significantly lower ($p < 0.001$) compared to the conventional group (38.5 ± 9.4 seconds) with a mean difference of more than 13 seconds. Moreover, the video group patients have had fewer attempts at intubation (1.1 ± 0.3 vs. 1.6 ± 0.7, $p < 0.001$), and less optimizing surgical intervention was necessary (20.0% vs. 51.1, $p = 0.002$).

Table 3: Comparison of Intubation Outcomes

Outcome	Video Laryngoscopy	Conventional Laryngoscopy	p-value
Cormack–Lehane Grade I–II, n (%)	40 (88.9%)	26 (57.8%)	<0.001
First Attempt Success, n (%)	42 (93.3%)	31 (68.9%)	0.004
Intubation Time (sec), Mean ± SD	24.8 ± 6.2	38.5 ± 9.4	<0.001
Number of Attempts, Mean ± SD	1.1 ± 0.3	1.6 ± 0.7	<0.001
Optimizing Surgical interventions, n (%)	9 (20.0%)	23 (51.1%)	0.002

Adverse Effects

Adverse airway events were much less in the patients who were intubated through video laryngoscopy. The desaturation of oxygen was found in 8.9% of the video and 26.7% of the conventional group ($p = 0.03$). The video group also had lower airway trauma of 4.4% versus the conventional laryngoscopy of 20.0% ($p = 0.03$). There were only 1 patient (2.2%) esophageal intubated in the video group and six patients (13.3%) in the conventional group ($p = 0.04$). Video laryngoscopy resulted in a significant decrease in hemodynamic instability (11.1% versus 31.1%, $p = 0.02$) and physiological tolerance.

Table 4: Adverse Intubation-Related Events

Adverse Event	Video Laryngoscopy n (%)	Conventional Laryngoscopy n (%)	p-value
Desaturation	4 (8.9%)	12 (26.7%)	0.03
Airway Trauma	2 (4.4%)	9 (20.0%)	0.03
Esophageal Intubation	1 (2.2%)	6 (13.3%)	0.04
Hemodynamic Instability	5 (11.1%)	14 (31.1%)	0.02

Correlation Outcomes

Following stratification, the success rates were higher in subgroups with video laryngoscopy. The video laryngoscopy intubation success rate was found to be 96% among patients aged ≤40 years versus 68% when using conventional laryngoscopy ($p = 0.03$). In the same case, the success rate in ASA I in the video group was 96.3% compared to 72.0% in the conventional group ($p = 0.02$). Such results prove that the dominance of video laryngoscopy was retained following adjustment of possible confounders.

Table 5: Post-Stratification Analysis of Intubation Success

Stratification	Group	Success n (%)	Failure n (%)	p-value
Age ≤40 years	Video	24 (96.0%)	1 (4.0%)	0.03
	Conventional	17 (68.0%)	8 (32.0%)	
ASA I	Video	26 (96.3%)	1 (3.7%)	0.02
	Conventional	18 (72.0%)	7 (28.0%)	

Efficient intubation was greatly correlated with good visualization of the glottic area and efficiency of the procedures. In patients with Cormack -Lehane grades I-II, intubation was successful in 93.9% and failed in 6.1% ($p = 0.001$).

With more than a single intubation attempt, the failure rates were much higher as most of the failures (45.5%) occurred (p = 0.002). Optimizing surgical interventions were also associated with failure and the time of excess of 30 seconds of intubation was also significantly related to failure which supports the clinical significance of rapid and well-viewed intubation.

Table 6: Association of Airway Variables with Intubation Success

Variable	Successful n (%)	Failed n (%)	p-value
Cormack–Lehane I–II	62 (93.9%)	4 (6.1%)	<0.001
>1 Attempt	18 (54.5%)	15 (45.5%)	0.002
Optimizing Surgical interventions	19 (59.4%)	13 (40.6%)	0.01
Time >30 sec	21 (56.8%)	16 (43.2%)	0.004

DISCUSSION

The main purpose of the study was to critically compare video laryngoscopy and conventional direct laryngoscopy in patients with predicted difficult airways characterized by Modified Mallampati class III and IV. Video laryngoscopy showed a much higher first attempt intubation success rate of 93.3% than the conventional laryngoscopy group, which was 68.9% with a statistically significant difference (p = 0.004). This result is also similar to that of Khan et al. (2021), who indicated that first-pass success rates were 92% with video laryngoscopy compared to 67% with direct laryngoscopy in predicted difficult airways. The scale of change improving in the current study supports the clinical validity of first-attempt success which has been closely linked with the minimization of hypoxic occurrences and airway injuries (Khan et al., 2021). The mechanistic process behind the improved success is due to the indirect glottic visualization and does not require full airway axis alignment (Luqman et al., 2024). A meta-analysis of more than 600 patients showed similar population-based results that pooled odds ratio adjusted in favor of video laryngoscopy to facilitate successful intubation in challenging airways (Vargas et al., 2021).

Glottic visualization evaluated by the Cormack-Lehane system of grading was much higher in the video laryngoscopy group with 88.9% of patients having grade I-II view against 57.8% in the conventional group (p < 0.001). This high absolute difference of 31.1% is similar to those of Richa et al., (2024), who found that in difficult cases of the airways, 85-90% of cases had better glottic views with the aid of video-assisted devices. Shiga et al. (2005) have already shown that poor glottic views are closely associated with failed intubation, and this fact puts the situation in context with the escalated failure rate in the traditional group in the current research. The enhanced optimalization of the video laryngoscopy is specifically pertinent in Mallampati III and IV patients, in which there is limited exposure in direct line-of-sight because of the limiting effect of the tongue volume and oropharyngeal space (Richa et al., 2024). The constraints in these body parts are relatively more disadvantaged to direct laryngoscopy but are partially avoided by camera-based blades (Panwar et al., 2020). This current result is thus mechanistic validation that improved visualization leads to superior procedural results. As shown in a multicenter randomized trial by Panwar et al., (2020), the video laryngoscopy performed a 30% improvement in glottic view grades. This body of evidence provides additional support to the adoption of video laryngoscopy as preferential in the case of the anticipated difficult airways.

This study also found that video laryngoscopy was much better than video laryngoscopy based on procedural efficiency in terms of intubation time and attempts. The video group (24.8 ± 6.2) compared to conventional group (38.5 ± 9.4) showed an average difference of 13.7 seconds (p < 0.001) in mean intubation time. This decrease is clinically significant because there is a direct relationship between protracted intubation time and hypoxemia and sympathetic stress reaction (Ruderman et al., 2022). Similar results were achieved by Köhl et al., (2024) who found that the mean intubation duration in the case of the video laryngoscopy was 26 seconds as compared to 41 seconds in the case of Macintosh laryngoscopy in difficult airway cases. Also, the average of tries was lower greatly in the video group (1.1 ± 0.3) compared with conventional group (1.6 ± 0.7), which also supports procedural ease. Recurrent attempts are also known to exponentially enlarge airways related complications (Köhl et al., 2024). Improved ergonomics and visualization is further supported by the fact that the surgical interventions resulting in the video group required reduction to optimize (20.0% vs. 51.1%, p = 0.002).

Unanticipated intubation related incidences were dramatically lower in patients intubated with video laryngoscopy highlighting its safety profile. A decrease in oxygen desaturation to less than 90% was found in 8.9% of the video group as compared to 26.7% in the conventional group (p = 0.03), which is equivalent to three times the change. Likewise, the airway trauma was found in 4.4% of video laryngoscopy and 20.0% with conventional

laryngoscopy (p = 0.03). The findings are in agreement with extensive observational data by Liu et al., (2019) which associated the number of repeated direct laryngoscopy attempts with a high probability of trauma and hypoxic injury. Video group also had a significant decrease in esophageal intubation (2.2% vs. 13.3%, p = 0.04) as there was an improvement in anatomical orientation in advancing tubes. A video laryngoscopy was associated with hemodynamic instability in 11.1% of cases, whereas the conventional technique was associated with 31.1% (p = 0.02), probably because of lower force and the duration of laryngoscopy (Begum et al., 2025). Commonly measured physiological responses have also undergone similar decrease in the video-assisted airway devices in randomized trials (Liu et al., 2019). In post-stratification analysis, it was found that the benefit of video laryngoscopy was maintained in the major demographic and clinical subgroups. Video laryngoscopy was associated with a success in intubation in 96.0% of case of intubation among patients aged ≤40 years versus 68.0% in the conventional group (p = 0.03). Likewise, in ASA I patients the success rates were 96.3% with video laryngoscopy compared with 72.0% with conventional laryngoscopy (p = 0.02). These results indicate that the given advantage was not due to age or initial physiological condition. Similar subgroup analyses were performed by Sansone et al., (2023), which revealed similar benefits of video laryngoscopy regardless of patient demographics (Sansone et al., 2023). This inter-rater reliability gives cause-effect inferential strength and lowers chances of selection bias in results. The findings of this nature are essential in clinical decision making since they reflect a wide applicability of video laryngoscopy in elective practice.

The correlation analysis also helped in explaining the airway variables with the success of intubation in this study. Favorable Cormack Lehane grades I to II were linked to a success rate of 93.9% with 6.1 only failures (p < 0.001). Conversely, repeat attempts failed in more than one attempt at intubation (45.5% p = 0.002), which indicates the compounding risk of repeated intubation. Optimizing surgical interventions were also significantly correlated to fail, and unsuccessful intubations comprised 40.6% of that (p = 0.01). The failure rate of intubation was found to be 43.2% with more than 30 seconds of intubation time (p = 0.004), which highlighted the role of speed in the procedure. The latter relations are strongly justified by the previous airway studies that have shown that visualization quality and time-to-intubation are independent variables of success (Zhu et al., 2019). Zhu et al., (2019) also stated that better visualization is not enough without the transfer to effective tube delivery. The current results confirm that video laryngoscopy has a positive impact on various interconnected factors of success.

Although the study has strengths in it, there are a number of limitations that should be considered. Single-center design can be a limitation because it will not be able to fully generalize the results to other institutions that might have different population of patients, other operators and availability of resources. Even though randomization was done, non-probability consecutive sampling can result in selection bias. No formal measurement of operator experience with video laryngoscopy was done and might have affected the time of intubation and success. The sample was limited to elective surgical patients who had an ASA physical status of I and II, which restricted its application to the emergency context or the high-risk groups. Also, long-term postoperative airway complications were not measured, and therefore, conclusions could be made on the immediate peri-intubation results only. To further confirm these findings, future multicenter research that will include a larger sample size, standardized operator training, and a variety of clinical settings are required.

CONCLUSION

This randomized controlled trial proved that in patients with expected difficult airways characterized by the Modified Mallampati class III and IV, video laryngoscopy is a better method of utilizing conventional direct laryngoscopy. Video laryngoscopy had a high rate of first-attempt successful intubation of 93.3% in the video laryngoscopy group versus 68.9% in the conventional group and glottic visualization with Cormack-Lehane I-II views in 88.9% of patients vs. 57.8% of conventional group. There was also a significant enhancement of procedural efficiency, which was illustrated in a reduced mean intubation time of 24.8 ± 6.2 seconds versus 38.5 ± 9.4 seconds and reduced intubation attempts. Compared to the use of video laryngoscopy, the need to optimize surgical interventions decreased by over 50%, and video laryngoscopy resulted in a significant reduction in adverse events, including desaturation, airway trauma, esophageal intubation, and hemodynamic instability. Overall, the results argue that video laryngoscopy should be used preferentially to manage airways in patients with predicted difficult airways to improve efficacy and patient safety.

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