https://doi.org/10.29309/TPMJ/2026.33.09.10475 www.theprofesional.com

ORIGINAL ARTICLE

Comparison of stress response between conventional laryngoscopy versus video laryngoscopy in patients undergoing general anesthesia.

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ABSTRACT… Objective: To compare the hemodynamic stress response between video laryngoscopy and conventional direct laryngoscopy in patients undergoing general anesthesia. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Anesthesia, Fauji Foundation Hospital, Rawalpindi. **Period:** Oct-2025 to Dec-2025. **Methods:** A total of 192 patients aged 18–50 years, belonging to ASA class I–II and undergoing elective surgery under general anesthesia were randomized into two equal groups. Patients in Group VL underwent video laryngoscopy while patients in Group DL underwent conventional direct laryngoscopy. The primary outcomes were hemodynamic parameters recorded at baseline (T0), during laryngoscopy (T1), at intubation (T2), and at one minute post-intubation (T3). These outcomes were compared between the two groups by applying independent t-test, where a p-value < 0.05 was considered significant. **Results:** Mean age of patients was 40±7.57 years, ranging from 18 to 50 years with a slightly higher number of male patients (53.13%) compared to the females (46.88%). The results showed an expected increase in HR and BP during laryngoscopy and intubation in both groups; however, analysis of the primary outcomes confirmed that the magnitude of the increase was significantly lower in the VL group compared to the DL group at T1, T2, and T3. Specifically heart rate, systolic blood pressure, diastolic blood pressure and MAP were significantly lower in the video laryngoscopy group at T2 (p< 0.0001). **Conclusion:** Video laryngoscopy provides a significantly reduced stress response regarding hemodynamic changes compared to conventional laryngoscopy in patients undergoing general anesthesia.

Key words: Airway Management, Hemodynamic Stress Response, Laryngoscopy, Tracheal Intubation, Video Laryngoscopy.

Article Citation: Khawar O, Ahmad K, Ahmad W, Mujtaba H. Comparison of stress response between conventional laryngoscopy versus video laryngoscopy in patients undergoing general anesthesia. Professional Med J 2026; 33(09):1647-1652.
https://doi.org/10.29309/TPMJ/2026.33.09.10475

INTRODUCTION

Endotracheal intubation to secure the airway is a critical component of general anesthesia (GA) and serves as a fundamental procedure in anesthetic practice.

However, this process of laryngoscopy and intubation primarily triggers mechanical stimulation of the tongue and oropharyngeal structures, activates nociceptive pathways, and initiates a physiological stress response mediated by sympathetic discharge and catecholamine release.[1,2] This discharge of catecholamines during laryngoscopy elicits a reflex autonomic response. The surge results in abrupt hemodynamic alterations in form of increased heart rate (HR) and blood pressure (BP), which enhances the consumption of oxygen by the myocardium. While often transient, these changes may have significant clinical consequences, particularly in patients with preexisting cardiovascular (CV) disease, elevated intracranial pressure, or impaired autonomic regulation.[3,4] Understanding and minimizing this hemodynamic stress response are critical determinants of perioperative safety and therefore remains an important objective during intubation.[5]

It is reported that the magnitude of these changes is influenced by multiple factors, including the duration of laryngoscopy, expertise of the operator, patient profile and type of laryngoscopic technique employed during the process. Laryngoscopic technique is in fact a primary driver of the hemodynamic stress response during the procedure of intubation.[6]

Direct laryngoscopy (DL), which is classically performed with the use of Macintosh blade, has been taken as standard technique for endotracheal intubation.

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Article received on:
13/03/2026
Accepted for publication:
22/07/2026

The technique necessitates significant lifting force and manipulation of the cervical spine. DL thereby causes stimulation of oropharyngeal nociceptors and pressure receptors, and triggers a potent sympathoadrenal discharge that results in tachycardia, increased myocardial contractility, and elevated BP. Similar limitations have been reported across studies evaluating the hemodynamic impact of other DLs including Miller laryngoscope. This response is dangerous particularly for patients already suffering from ischemic heart disease (IHD). Operator's skill and duration of procedure further influence the intensity of these changes.[7]

To mitigate this risk, video laryngoscopes have been developed as less stimulating alternatives.

Video laryngoscopy (VL) (which includes the systems such as Glidescope, C-MAC, and video-enabled Airtraq) has been introduced as important alternative to DL in recent years. The technique uses an integrated camera at the blade tip and provides an indirect, high-resolution view of the glottis without requiring the traditional anatomical alignments. VL reduces the forceful manipulation, cervical extension, and supraglottic contact, thereby able to minimize the sympathetic stimulation. This enhanced visualization is particularly beneficial in patients presenting with restricted airway exposure. Additionally, VL also decreases intubation attempts and laryngoscopy time, with early studies demonstrating the benefits in shape of fewer hemodynamic fluctuations and improved cardiovascular stability during intubation.[8,9]

Hence, the studies show that design and configurations of the laryngoscope blade has a significant role in the stress response and hemodynamic changes. VL techniques such as the C-MAC are able to reduce the intubation time and leads to a favorable hemodynamic profile due to less stimulation of sympathetic system.[10]

As both DL and VL are widely used in surgical practice in Pakistan, there is a growing need for local evidence containing comparative data. This study was therefore planned to compare the systolic BP, diastolic BP, mean arterial pressure (MAP) and HR between the conventional DL and the VL in patients undergoing general anesthesia. These findings will provide important insight to adopt appropriate technique for different patient profiles and risks to generate favorable outcomes.

METHODS

This randomized controlled trial was conducted at the Department of Anesthesia, Fauji Foundation Hospital, Rawalpindi, from Oct-2025 to Dec-2025, after securing approval from the ethical review committee of the hospital (889/RC/FFH/RWP/29-7-25).

Sample size was calculated by using the WHO sample size calculator taking 95% confidence interval, 80% study power, and α = 5% (two sided). The mean HR in patients undergoing VL was taken as 77.10±6.2 BPM while the mean HR in patients undergoing DL was taken as 79.68±6.54 BPM.[11] The estimated sample size was calculated as n= 192 with 96 patients in each group.

A total of 192 patients (aged 18 to 50 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and with Mallampati grades I or II) scheduled for elective surgical procedures requiring GA with endotracheal intubation were included in this study. Patients were then randomized to two groups named Group VL and Group DL, using computer-generated randomization, with 96 patients in each group.

Exclusion criteria consisted of patients undergoing emergency surgeries, pregnant women, and individuals with diabetes mellitus, those who had a previous upper airway surgery or a history of difficult intubation.

Informed written consent was obtained from all these participants prior to inclusion. All the baseline demographics and clinical characteristics were recorded for each patient. All the participants then received standardized premedication administered 15 minutes prior to induction. This consisted of glycopyrrolate 0.2 mg IV, midazolam 1 mg IV, ondansetron 4 mg IV, and nalbuphine 0.1 mg/kg IV and pre-oxygenation with 100% oxygen for three minutes. Anesthesia induction was then achieved using propofol 2 mg/kg IV, which was followed by muscle relaxation with atracurium 0.5 mg/kg IV. Controlled ventilation was ensured for three minutes prior to laryngoscopy to provide adequate neuromuscular relaxation. Standard basic monitoring was in place in each case including ECG, noninvasive BP, SpO_2 and capnography and IV access was confirmed before induction.

In Group VL, patients underwent intubation by using C-MAC video laryngoscope while in group DL patients were intubated with a standard Macintosh laryngoscope. Experienced anesthetists (at least 3 years' clinical experience) performed intubation in both the groups to ensure minimal variability regarding operator skill.

Endotracheal intubation was confirmed afterwards by auscultation and capnography.

All the hemodynamic parameters including HR, systolic and diastolic BP, and MAP were noted at baseline (T0), and then at the time of laryngoscopy (T1), intubation (T2) and finally at 1 minute after completion of intubation process (T3).

Data were entered and analyzed using SPSS 26. Quantitative variables were calculated in form of mean ± standard deviation (SD) (normality was assessed using the Shapiro–Wilk test) while qualitative variables were shared in shape of frequency and percentages. Comparisons between the groups were done at four predefined time points: baseline (pre-induction), during laryngoscopy, at intubation, and at 1 minute post-intubation. A p-value <0.05 was considered statistically significant.

RESULTS

Mean age of patients in this study was 40±7.57 years, ranging from 18 to 50 years. The number of male patients was 102 (53.13%) while female patients were 90 (46.88%) in overall study population. The group wise demographics and clinical details are shown in Table-I.

TABLE-I

Demographics and clinical details n= 192

Demographics and Clinical Details		Group VL (n=96)	Group DL (n=96)
Age (Mean± SD) years		39.47±8.07	40.53±7.05
Gender	Male n (%)	50 (52.08)	52 (54.17)
	Female n (%)	46 (47.92)	44 (45.83)
BMI (Mean± SD) Kg/m^2		25.75± 3.37	26.46± 2.5
ASA class	I n (%)	56 (58.33)	51 (53.13)
	II n (%)	40 (41.66)	45 (46.88)
Mallampati Grade	I n (%)	46 (47.92)	47 (48.96)
	II n (%)	50 (52.08)	49 (51.04)

The results showed an expected increase in HR and BP during laryngoscopy and intubation in both groups; however, analysis of the primary outcomes of the study confirmed that the magnitude of the increase was significantly lower in the VL group as compared to the DL group at T1, T2, and T3 as shown in Table-II, III and IV.

DISCUSSION

The results of our study demonstrated that both DL and VL techniques are associated with increased hemodynamic parameters. However, this effect was significantly lower in the VL group for all measured variables including HR, systolic BP, diastolic BP and MAP at all the time points recorded during the study including at the time of laryngoscopy ($p \leq 0.0001$), at intubation ($p<0.0001$) and at 1 minute after intubation ($p<0.0001$). These results highlight the clinical advantages of VL that can likely be explained by the reduced sympathetic stimulation, associated with indirect glottic visualization in VL compared to the conventional direct method.

TABLE-II

Comparison of changes in HR between the two groups n= 192

Heart Rate	Group VL (n=96)	Group DL (n=96)	P-Value
At T0 (Baseline) (Mean± SD)	76.09± 5.22	77.03±5.06	0.207
At T1 (at laryngoscopy) (Mean± SD)	83.79±4.19	85.97±3.4	0.0001
At T2 (at intubation) (Mean± SD)	88.32±1.5	90.59±3.08	<0.0001
At T3 (1 min. after intubation) (Mean± SD)	84.58±3.70	86.03±3.18	0.004

TABLE-III			
Comparison of changes in systolic BP between the two groups n= 192			
Systolic BP	**Group VL (n=96)**	**Group DL (n=96)**	**P-Value**
At T0 (Baseline) (Mean± SD)	122.77± 4.68	121.93±4.37	0.200
At T1 (at laryngoscopy) (Mean± SD)	126.72±3.52	129.49±3.66	<0.0001
At T2 (at intubation) (Mean± SD)	132.59±2.68	138.31±7.29	<0.0001
At T3 (1 min. after intubation) (Mean± SD)	126.11±2.95	128.78±2.14	<0.0001

TABLE-IV			
Comparison of changes in diastolic BP between the two groups n= 192			
Diastolic BP	**Group VL (n=96)**	**Group DL (n=96)**	**P-Value**
At T0 (Baseline) (Mean± SD)	82.33±4.57	82.54±4.72	0.755
At T1 (at laryngoscopy) (Mean± SD)	84.68±3.81	89.21±2.19	<0.0001
At T2 (at intubation) (Mean± SD)	88.58±4.16	91.47±3.39	<0.0001
At T3 (1 min. after intubation) (Mean± SD)	85.5±3.13	89.9±2.12	<0.0001

TABLE-V			
Comparison of changes in MAP between the two groups n= 192			
Mean Arterial Pressure	**Group VL (n=96)**	**Group DL (n=96)**	**P-Value**
At T0 (Baseline) (Mean± SD)	95.81±3.30	95.67±3.35	0.771
At T1 (at laryngoscopy) (Mean± SD)	98.69±2.80	102.64±1.89	<0.0001
At T2 (at intubation) (Mean± SD)	103.25±2.98	107.08±3.5	<0.0001
At T3 (1 min. after intubation) (Mean± SD)	99.39±2.33	102.86±1.42	<0.0001

These findings are aligned with previous work on the topic showing favorable hemodynamic response with VL owing to better visualization with reduced force needed for the procedure. Singh T et al. reported that control of the pressor response was significantly better with VL, with a lower MAP increase compared to DL (15% vs. 32%) and enhanced overall hemodynamic stability during intubation.[11] Similarly, improved hemodynamic stability during nasotracheal intubation using VL was also reported by Mehta JB et al. with significantly lower HR and MAP until 5 minutes post-intubation ($p<0.05$).[12] Jafra A et al. also reported significantly lower primary hemodynamic response with VL during intubation compared to DL (15% vs. 25%, $p<0.01$), reinforcing a clear clinical advantage.[13] Similar findings were shared by Arunkumar R et al. while comparing the hemodynamic responses between Macintosh laryngoscopes and VL during intubation. VL produced significantly lower hemodynamic stress recorded at 1 and 3 minutes after intubation (p = 0.000 and 0.02). These procedural advantages of VL with shorter laryngoscopy and intubation times and hemodynamic stability further confirmed the superiority of this technique versus DL.[14] Advantages of VL were also confirmed in Pakistani population in a study by Markhand NN et al. in 244 CABG patients where VL significantly reduced mean HR (78.06±6.10 vs. 84.30±5.14 bpm; p=0.001) and MAP (83.47±2.69 vs. 86±3.58 mmHg; p=0.001) compared to DL. Superiority of VL was thereby demonstrated in terms of superior hemodynamic stability and decreased intubation time (22.19±4.33 vs. 24.08±5.91 seconds; p=0.001).[15]

Although most of the evidence supports the superiority of VL, there are studies which mention similar results with both the techniques. In a recently published study by Shikha D et al. involving 110 patients, HR and BP decreased following induction but increased significantly during intubation and at 3 minutes post-intubation compared with baseline ($p < 0.05$) in both DL and VL groups. However similar hemodynamic responses with conventional and video laryngoscopes were found with no significant differences in HR and BP throughout the procedure.[16] The findings shared by Devaraj P et al. also shared similar hemodynamic responses to

Macintosh versus VL in 150 ASA I–II adults. HR and BP both decreased after intubation at 1, 3, and 5 minutes, with no significant intergroup differences observed at these times ($p > 0.05$). Hence the study concluded that VL offers procedural advantages without any superior hemodynamic benefit.[17] These discrepancies among results may be related to certain variations which may influence the outcomes such as patient selection, anesthetic depth, duration of the intubation process, baseline CV and operator's experience.

Despite some variability in results, the hemodynamic benefits of VL are supported by higher-level evidence. A meta-analysis of 8 trials compared hemodynamic responses between VL and conventional DL and confirmed that VL significantly reduced the HR (mean difference = −7.29; 95% CI, −10.9 to −3.62; $P < .0001$) and MAP (mean difference = −11.5; 95% CI, −20.4 to −2.65; $P = .01$) at 1 minute post-intubation in comparison to DL.[18]

In summary, the present study adds to the evidence supporting VL as a favorable airway management technique by minimizing sympathetic stimulation during laryngoscopy and intubation.

The single center design of this study may limit the generalizability of these results. Moreover, our study patients were having normal airways and the findings may not be truly applicable to the high-risk patients or those with anticipated difficult-airways.

CONCLUSION

VL demonstrates a clear advantage over conventional DL in minimizing the hemodynamic stress response during laryngoscopy and tracheal intubation. Indirect visualization offered by VL while requiring less forceful manipulation may be especially beneficial for patients susceptible to abrupt sympathetic surges. Conventional DL is widely practiced however, these findings support the broader use of VL as a safer alternative in routine anesthesia practice to enhance the perioperative safety and improve patient outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Omair Khawar:** Manuscript writing, design, conception.
2	**Khaleel Ahmad:** Critical review.
3	**Waqar Ahmad:** Acquisition, analysis.
4	**Hassan Mujtaba:** Interpretation of data.