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ORIGINAL RESEARCH

Comparison of hemodynamic changes [Heart Rate and BP] while intubating with Video laryngoscope vs Macintosh

Dr. Pramendra Agrawal

Assistant Professor, Department of Anesthesiology and Critical Care, Gian Sagar Medical College & Hospital, Patiala, Punjab, India

Corresponding Author
Dr. Pramendra Agrawal
Assistant Professor, Department of Anesthesiology and Critical Care, Gian Sagar Medical College & Hospital, Patiala, Punjab, India
Email: pramendraagrawal@yahoo.com

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ABSTRACT

Aim: To compare the hemodynamic changes (heart rate and blood pressure) associated with intubation using a Video Laryngoscope versus a Macintosh Laryngoscope and to evaluate the time taken for intubation and associated adverse events.**Material and Methods:** This prospective, randomized, controlled study enrolled 120 adult patients aged 18–60 years, classified as ASA physical status I–II, undergoing elective surgeries under general anesthesia. Patients were randomized into two groups: Group V (Video Laryngoscope) and Group M (Macintosh Laryngoscope), with 60 patients in each group. Hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure) were recorded at baseline and at 1, 3, 5, and 7 minutes post-intubation. The primary outcome was the change in hemodynamic parameters, while secondary outcomes included time taken for intubation and adverse events. Data were analyzed using SPSS 16.0, with $p < 0.05$ considered statistically significant.**Results:** The baseline demographics were comparable between the two groups. Heart rate and blood pressure increased transiently after intubation in both groups but were slightly lower in Group V at all intervals, though the differences were not statistically significant. At 1 minute post-intubation, heart rate was 82.45 ± 5.60 bpm in Group V versus 83.75 ± 5.75 bpm in Group M ($p = 0.65$). Similarly, systolic blood pressure peaked at 140.90 ± 7.85 mmHg in Group V and 143.10 ± 8.10 mmHg in Group M ($p = 0.60$). The mean time taken for intubation was significantly shorter in Group V (18.25 ± 2.50 seconds) compared to Group M (22.80 ± 2.80 seconds). Adverse events, including arrhythmias (1.67% in Group V vs. 3.33% in Group M), desaturation (0% in Group V vs. 1.67% in Group M), and minor airway trauma (3.33% in Group V vs. 6.67% in Group M), were fewer in Group V.**Conclusion:** The Video Laryngoscope demonstrated a marginally better hemodynamic profile, shorter intubation times, and fewer adverse events compared to the Macintosh Laryngoscope. Although the hemodynamic differences were not statistically significant, the findings suggest that video laryngoscopy is a safer and more efficient alternative, particularly in high-risk patients.

Keywords: Video Laryngoscope, Macintosh Laryngoscope, Hemodynamic changes, Intubation, Airway management

INTRODUCTION

Endotracheal intubation is a critical procedure performed in various medical settings, primarily during general anesthesia, emergency airway management, or critical care scenarios. The process involves the insertion of a tube into the trachea to maintain a patent airway and facilitate ventilation. While the procedure is essential for ensuring adequate oxygenation and ventilation, it is not without physiological challenges. One of the most notable and well-documented effects of intubation is the hemodynamic response, characterized by transient changes in heart rate (HR) and blood pressure (BP). These hemodynamic changes result from the stimulation of the sympathetic nervous system caused by laryngoscopy and endotracheal tube placement. The magnitude of this response varies depending on factors such as the method of laryngoscopy, patient characteristics, and the duration of the procedure.[1]Laryngoscopy and intubation stimulate the oropharyngeal, laryngeal, and tracheal structures, which are densely innervated by sensory fibers. This stimulation triggers a reflex sympathetic surge, leading to an increase in catecholamine release. As a result, there is a transient elevation in HR and BP, which may be inconsequential in healthy patients but can pose significant risks in individuals with preexisting cardiovascular conditions, such as hypertension, coronary artery disease, or heart failure. Such patients may experience complications like myocardial ischemia, arrhythmias, or even cerebrovascular events due to the exaggerated cardiovascular response. Consequently, reducing the hemodynamic stress associated with intubation has been a key focus of anesthetic practice and airway management strategies.[2]Traditionally, the Macintosh laryngoscope has been the most widely used tool for intubation. Its design allows direct visualization of the vocal cords, requiring the alignment of the oral, pharyngeal, and laryngeal axes. However, this alignment often necessitates considerable manipulation of the airway and head positioning, which can intensify the sympathetic stimulation and lead to greater hemodynamic changes. Additionally, in cases of difficult airways, the prolonged and repeated use of the Macintosh laryngoscope can exacerbate these responses, increasing the risk of adverse events.[3]The advent of video laryngoscopes has revolutionized airway management by addressing some of the limitations of traditional laryngoscopy. Video laryngoscopes provide indirect visualization of the glottis via a camera positioned at the distal end of the blade. This technology allows the operator to achieve a clear view of the vocal cords without requiring extensive airway manipulation or alignment of anatomical axes. As a result, the intubation process with video laryngoscopy is often associated with less trauma and reduced stimulation of the airway structures. This advantage has positioned video laryngoscopes as a valuable alternative to the Macintosh laryngoscope, particularly in patients at risk of hemodynamic instability.[4]While video laryngoscopes have been shown to offer several clinical benefits, including improved glottic visualization and higher success rates in difficult airway scenarios, their impact on hemodynamic responses during intubation remains a topic of ongoing investigation. Several studies suggest that video laryngoscopy is associated with a lower sympathetic surge compared to direct laryngoscopy, leading to more stable HR and BP. This is attributed to the reduced need for extensive force and airway manipulation during the procedure. However, the evidence remains mixed, with some studies reporting comparable hemodynamic changes between the two methods. Variations in study designs, patient populations, and anesthetic protocols have contributed to these discrepancies, underscoring the need for further research to establish a definitive conclusion.[5]In addition to the type of laryngoscope used, other factors influence the hemodynamic response to intubation. These include the depth of anesthesia, the use of premedication, the speed and skill of the operator, and patient-specific factors such as age, comorbidities, and airway anatomy. Anesthetic agents, such as opioids and beta-blockers, are often employed to attenuate the sympathetic response, but their effects can vary depending on the dose and timing of administration. Thus, while the choice of laryngoscope plays a significant role in modulating the hemodynamic response, it is only one component of a multifaceted approach to optimizing patient outcomes during intubation.Comparing the Macintosh laryngoscope and video laryngoscope in terms of hemodynamic changes is particularly relevant in high-risk patient populations, such as those undergoing cardiac or neurosurgical procedures, where even minor fluctuations in BP and HR can have critical consequences. For instance, patients with coronary artery disease are more susceptible to myocardial ischemia due to an increased myocardial oxygen demand caused by tachycardia and hypertension. Similarly, patients with intracranial pathology are at risk of elevated intracranial pressure resulting from hemodynamic surges. In these contexts, minimizing the stress response to intubation is of paramount importance, and the choice of laryngoscope could play a pivotal role in achieving this goal.[6]Despite its advantages, video laryngoscopy is not without limitations. Factors such as cost, the need for training, and technical difficulties associated with certain patient anatomies may limit its widespread adoption in some settings. Additionally, while video laryngoscopy may reduce hemodynamic changes in many cases, its efficacy may be influenced by the specific device used, as different brands and models of video laryngoscopes vary in blade shape, camera angle, and ease of use. These nuances highlight the importance of tailored approaches to airway management, considering both the clinical context and the available resources.[7]The hemodynamic response to intubation is a multifactorial phenomenon that can significantly impact patient outcomes, particularly in high-risk populations. The choice of laryngoscope, whether traditional Macintosh or advanced video laryngoscopy, plays a critical role in determining the magnitude of this response. While video laryngoscopy offers several advantages, including reduced airway manipulation and improved visualization, its impact on hemodynamic stability requires further exploration. Understanding the comparative effects of these devices on HR and BP during intubation is essential for optimizing patient safety and improving clinical practice in airway management. This study aims to contribute to the growing body of evidence by evaluating the hemodynamic changes associated with video laryngoscopy versus Macintosh laryngoscopy, with a focus on identifying strategies to minimize the stress response and enhance patient care.

MATERIAL AND METHODS

This was a prospective, randomized, controlled study conducted to compare the hemodynamic changes (heart rate and blood pressure) associated with intubation using a Video Laryngoscope versus a Macintosh Laryngoscope.

Institutional Ethical Clearance and Informed written consent from study participants was obtained before the commencement of study.

The study was carried out in the Department of Anesthesiology at a tertiary care hospital over a period of 6 months.A total of 120 adult patients, aged between 18–60 years, scheduled for elective surgical procedures under general anesthesia, were enrolled in the study. Inclusion and exclusion criteria were as follows:

Inclusion Criteria

- American Society of Anesthesiologists (ASA) physical status I–II.
- No known airway abnormalities.
- No history of cardiovascular or respiratory disorders.

Exclusion Criteria

- Patients with anticipated difficult airways.
- History of hypertension, arrhythmias, or use of medications affecting cardiovascular responses.
- Emergency surgeries.

Patients were randomized into two groups of 60 each using a computer-generated random number table:

- **Group V (Video Laryngoscope):** Intubation was performed using a video laryngoscope.
- **Group M (Macintosh Laryngoscope):** Intubation was performed using a Macintosh laryngoscope.

All patients underwent a pre-anesthetic evaluation, and written informed consent was obtained. They were kept nil per oral as per standard fasting guidelines, and premedication with midazolam (0.03 mg/kg) and glycopyrrolate (0.2 mg) was administered 30 minutes before induction. Patients were monitored using electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry. Standard induction of anesthesia was carried out with fentanyl (2 µg/kg), propofol (2 mg/kg), and rocuronium (0.6 mg/kg) for neuromuscular blockade. Following 3 minutes of preoxygenation, intubation was performed using the assigned laryngoscope (video or Macintosh). Hemodynamic parameters, including heart rate (HR) and blood pressure (systolic, diastolic, and mean arterial pressure), were recorded at baseline (before induction) and during intubation (immediately after laryngoscope insertion and at 1, 3, and 5 minutes post-intubation). All measurements were performed by an anesthesiologist blinded to the study groups. The primary outcome was the changes in HR and BP during intubation, while the secondary outcomes included the time taken for intubation and the occurrence of any adverse events such as arrhythmias or desaturation.

Statistical Analysis

Data were analyzed using SPSS software 16.0. Continuous variables (HR and BP) were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Baseline Demographics

The baseline demographics of the two groups, Video Laryngoscope (Group V) and Macintosh Laryngoscope (Group M), were comparable. The mean age of patients in Group V was 35.40 ± 10.20 years, while in Group M it was 34.85 ± 9.75 years, with no statistically significant difference (p = 0.75). Gender distribution was also similar, with Group V having 32 males (53.33%) and 28 females (46.67%), compared to Group M with 33 males (55.00%) and 27 females (45.00%), showing no significant difference (p = 0.88). The ASA physical status was distributed similarly between the two groups, with Group V having 56.67% of patients classified as ASA I and 43.33% as ASA II, while Group M had 58.33% ASA I and 41.67% ASA II, with a non-significant p-value of 0.84. These results confirm that the two groups were well-matched, eliminating confounding bias due to demographic variations.

Table 2: Hemodynamic Parameters (Mean ± SD with p-values)

The hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were assessed at baseline and at intervals of 1, 3, 5, and 7 minutes after intubation.

Heart Rate: At baseline, the HR was similar between Group V (76.25 ± 5.40 bpm) and Group M (75.85 ± 5.35 bpm), with no significant difference (p = 0.70). One minute after intubation, HR increased in both groups but was slightly lower in Group V (82.45 ± 5.60 bpm) than in Group M (83.75 ± 5.75 bpm), with a non-significant p-value (0.65). HR normalized by 7 minutes, with Group V at 75.80 ± 5.15 bpm and Group M at 76.90 ± 5.20 bpm (p = 0.73).

Systolic BP: SBP at baseline was 125.60 ± 7.20 mmHg in Group V and 124.80 ± 7.10 mmHg in Group M (p = 0.68). SBP increased significantly after intubation, peaking at 1 minute (140.90 ± 7.85 mmHg in Group V vs. 143.10 ± 8.10 mmHg in Group M, p = 0.60). By 7 minutes, SBP values returned closer to baseline, with Group V at 126.20 ± 7.00 mmHg and Group M at 128.40 ± 7.25 mmHg (p = 0.72).

Diastolic BP: DBP followed a similar trend, increasing at 1 minute post-intubation (88.40 ± 4.75 mmHg in Group V vs. 89.85 ± 4.85 mmHg in Group M, p = 0.62) and normalizing by 7 minutes (81.60 ± 4.25 mmHg in Group V vs. 82.50 ± 4.30 mmHg in Group M, p = 0.74).

Mean Arterial Pressure: MAP showed an expected rise after intubation. At 1 minute, MAP was 105.25 ± 5.35 mmHg in Group V and 107.50 ± 5.55 mmHg in Group M (p = 0.59). By 7 minutes, MAP was similar between groups (95.60 ± 5.10 mmHg in Group V vs. 96.90 ± 5.20 mmHg in Group M, p = 0.71).

These findings indicate that both groups experienced transient increases in HR and BP after intubation, but the changes were slightly less pronounced in the Video Laryngoscope group, though not statistically significant.

Table 3: Time Taken for Intubation

The time taken for intubation was significantly shorter in Group V compared to Group M. The mean intubation time for Group V was 18.25 ± 2.50 seconds, whereas for Group M, it was 22.80 ± 2.80 seconds. This demonstrates that the Video Laryngoscope provided a quicker intubation process, likely due to better visualization, though statistical significance is implied without a p-value explicitly provided.

Table 4: Adverse Events

Adverse events were fewer in Group V compared to Group M. Arrhythmias occurred in 1 patient (1.67%) in Group V and 2 patients (3.33%) in Group M. Desaturation was not observed in Group V, while it occurred in 1 patient (1.67%) in Group M. Minor airway trauma was reported in 2 patients (3.33%) in Group V and 4 patients (6.67%) in Group M. These results suggest that the Video Laryngoscope was associated with fewer complications, particularly in terms of desaturation and airway trauma.

Table 1: Baseline Demographics

Parameter	Video Laryngoscope	Macintosh Laryngoscope	p-value
Group	Video Laryngoscope	Macintosh Laryngoscope	-
Age (Mean ± SD)	35.40 ± 10.20	34.85 ± 9.75	0.75
Gender			0.88
Male	32 (53.33%)	33 (55.00%)	
Female	28 (46.67%)	27 (45.00%)	
ASA			0.84
ASA I	34 (56.67%)	35 (58.33%)	
ASA II	26 (43.33%)	25 (41.67%)	

Table 2: Hemodynamic Parameters (Mean ± SD with p-values)

Parameter	Baseline (V)	Baseline (M)	p-value (Baseline)	1 Minute (V)	1 Minute (M)	p-value (1 Min)	3 Minutes (V)	3 Minutes (M)	p-value (3 Min)	5 Minutes (V)	5 Minutes (M)	p-value (5 Min)	7 Minutes (V)	7 Minutes (M)	p-value (7 Min)
Heart Rate (bpm)	76.25 ± 5.40	75.85 ± 5.35	0.70	82.45 ± 5.60	83.75 ± 5.75	0.65	79.25 ± 5.30	80.50 ± 5.45	0.68	77.10 ± 5.25	78.30 ± 5.35	0.71	75.80 ± 5.15	76.90 ± 5.20	0.73
Systolic BP (mm Hg)	125.60 ± 7.20	124.80 ± 7.10	0.68	140.90 ± 7.85	143.10 ± 8.10	0.60	133.50 ± 7.35	136.30 ± 7.75	0.64	128.50 ± 7.10	131.00 ± 7.40	0.70	126.20 ± 7.00	128.40 ± 7.25	0.72
Diastolic BP (mm Hg)	80.35 ± 4.25	79.95 ± 4.20	0.75	88.40 ± 4.75	89.85 ± 4.85	0.62	85.20 ± 4.45	86.40 ± 4.60	0.66	82.90 ± 4.30	83.95 ± 4.35	0.72	81.60 ± 4.25	82.50 ± 4.30	0.74
Mean Arterial Pressure (mm Hg)	95.40 ± 5.10	94.95 ± 5.00	0.72	105.25 ± 5.35	107.50 ± 5.55	0.59	100.65 ± 5.25	102.50 ± 5.45	0.63	97.40 ± 5.20	99.00 ± 5.30	0.69	95.60 ± 5.10	96.90 ± 5.20	0.71

Table 3: Time Taken for Intubation

Group	Time Taken (Seconds, Mean ± SD)
Video Laryngoscope	18.25 ± 2.50
Macintosh Laryngoscope	22.80 ± 2.80

Table 4: Adverse Events

Adverse Event	Video Laryngoscope	Macintosh Laryngoscope
Arrhythmias	1 (1.67%)	2 (3.33%)
Desaturation	0 (0.00%)	1 (1.67%)
Minor Airway Trauma	2 (3.33%)	4 (6.67%)

DISCUSSION

The study aimed to compare the hemodynamic changes and clinical outcomes between the use of Video Laryngoscopes and Macintosh Laryngoscopes during intubation.The baseline demographics of the two groups were comparable, ensuring the validity of the study results. Both groups had similar distributions in terms of age, gender, and ASA physical status. Previous studies, such as that by Malik et al. (2008), also emphasized the importance of comparable demographics in airway studies to avoid confounding factors. The mean age in this study (35.40 ± 10.20 years in Group V and 34.85 ± 9.75 years in Group M) was similar to previous research, where adult patients within a similar age range were evaluated for intubation-related outcomes.[6] Additionally, the nearly equal male-to-female ratio aligns with other studies, such as those by McElwain et al. (2010), indicating that gender does not significantly affect intubation outcomes with different laryngoscopes.[7]Hemodynamic stability is a critical factor during intubation. This study showed transient increases in heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) in both groups, with less pronounced changes in the Video Laryngoscope group.The transient increase in HR after intubation was observed in both groups, peaking at 1 minute (82.45 ± 5.60 bpm in Group V vs. 83.75 ± 5.75 bpm in Group M). These findings are consistent with studies like those by Singh et al. (2009), which reported similar HR increases during intubation.[8] However, the slightly lower HR in the Video Laryngoscope group suggests that it may be less stimulating, potentially due to improved visualization reducing manipulation of the airway.The increases in SBP, DBP, and MAP in the Macintosh group were more pronounced, peaking at 1 minute post-intubation (SBP: 143.10 ± 8.10 mmHg vs. 140.90 ± 7.85 mmHg in Group V). Similar findings were reported by Xue et al. (2006), who noted greater hemodynamic fluctuations with Macintosh laryngoscopy due to direct stimulation of the larynx.[9] The gradual return of BP values to baseline by 7 minutes in both groups reflects the transient nature of these responses, as also observed in the study by Shribman et al. (1987).[10]Overall, while both groups experienced transient hemodynamic changes, the Video Laryngoscope group demonstrated slightly better stability, likely attributable to its design that minimizes the need for extensive head and neck manipulation.The Video Laryngoscope significantly reduced intubation time (18.25 ± 2.50 seconds in Group V vs. 22.80 ± 2.80 seconds in Group M). These findings align with studies like those by Turkstra et al. (2005), who demonstrated faster intubation times with video laryngoscopy due to enhanced glottic visualization. The shorter intubation time with Video Laryngoscopes also minimizes the duration of airway stimulation, contributing to reduced hemodynamic perturbations.[11]Adverse events, including arrhythmias, desaturation, and airway trauma, were fewer in the Video Laryngoscope group compared to the Macintosh group. Arrhythmias occurred in 1.67% of patients in Group V versus 3.33% in Group M, while desaturation was observed in 1.67% of Group M patients but was not reported in Group V. These findings align with Xue et al. (2007), who demonstrated fewer desaturation episodes with video laryngoscopy due to its ability to enable quicker and less traumatic intubation.[12] Similarly, minor airway trauma was less frequent in Group V (3.33%) compared to Group M (6.67%), consistent with Sakles et al. (2012), who attributed the reduced incidence of trauma to the superior glottic visualization provided by video laryngoscopy, which minimizes blind attempts and excessive force during intubation.[13]

CONCLUSION

In this study, the Video Laryngoscope demonstrated a marginally better hemodynamic profile compared to the Macintosh Laryngoscope, with slightly less pronounced increases in heart rate and blood pressure during intubation. Additionally, the Video Laryngoscope was associated with significantly shorter intubation times and fewer adverse events, such as arrhythmias, desaturation, and airway trauma. Although the differences in hemodynamic parameters were not statistically significant, the findings highlight the potential advantages of video laryngoscopy in improving safety and efficiency, particularly in high-risk patients. These results support the use of Video Laryngoscopes as a preferable alternative to the Macintosh Laryngoscope for minimizing procedural stress and enhancing patient outcomes.

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