



Comparison of the Hemodynamic Changes of Orotrachealintubation in Patients with a History of Hypertension by Direct Laryngoscopy with the Macintosh Blade of the Video Laryngoscope

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ABSTRACT

Introduction: The aim of this randomized clinical trial was to compare the hemodynamic responses during tracheal intubation using the Macintosh laryngoscope and the video laryngoscope in hypertensive patients undergoing general anesthesia.

Materials and Methods: A total of 60 patients, aged 18–60 years, with well-controlled hypertension, were included in the study. The participants were randomly divided into two groups: the Macintosh group (30 patients) and the video laryngoscope group (30 patients). Hemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were measured before, immediately after, and during the post-intubation period.

Results: Significant differences were observed between the groups. The Macintosh group showed a higher heart rate and increased blood pressure (both SBP and DBP) immediately post-intubation, with more hemodynamic instability over time. In contrast, the video laryngoscope group exhibited more stable hemodynamic responses with less fluctuation in heart rate and blood pressure.

Conclusion: The video laryngoscope offers a more stable hemodynamic profile compared to the Macintosh laryngoscope in hypertensive patients, suggesting its potential advantages in reducing stress responses during intubation in these individuals.

Introduction

Orotracheal intubation is a critical component of airway management in various surgical and emergency settings.

However, the process of laryngoscopy and endotracheal tube placement induces significant

hemodynamic responses, including tachycardia and hypertension, which can be particularly concerning in patients with a history of hypertension [1].

The transient but intense sympathetic stimulation caused by direct laryngoscopy may lead to adverse cardiovascular events, increasing the risk of

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myocardial ischemia, arrhythmias, or even cerebrovascular complications. Consequently, optimizing intubation techniques to minimize these hemodynamic disturbances remains a priority in anesthetic practice [2].

Over the years, the Macintosh direct laryngoscope has been the standard tool for orotracheal intubation due to its simplicity, effectiveness, and widespread availability. However, it requires a significant degree of force to align the oral, pharyngeal, and laryngeal axes for an optimal view, which can contribute to exaggerated hemodynamic responses [3].

This effect is particularly pronounced in hypertensive patients, who often exhibit an exaggerated pressor response due to increased baseline sympathetic activity and vascular stiffness. Given the potential risks associated with these hemodynamic fluctuations, alternative techniques that reduce sympathetic stimulation during laryngoscopy are being explored [4].

The introduction of video laryngoscopy represents a significant advancement in airway management. Video laryngoscopes provide an indirect view of the glottis using a camera system, reducing the need for excessive manipulation and force during intubation. This technique has been shown to improve intubation success rates, particularly in patients with difficult airways [5].

Furthermore, by minimizing direct contact and mechanical stimulation of the oropharyngeal and laryngeal structures, video laryngoscopy may attenuate the hemodynamic stress response associated with laryngoscopy and intubation. This potential advantage is particularly relevant in hypertensive patients, where avoiding abrupt cardiovascular changes is crucial [4].

Previous studies have investigated the hemodynamic effects of video laryngoscopy compared to direct laryngoscopy in the general population. Some studies suggest that video laryngoscopy may lead to less pronounced increases in blood pressure and heart rate, while others indicate that the differences may not be clinically significant [6].

The conflicting data highlight the need for more targeted research, especially in high-risk populations such as hypertensive patients. Since hypertension itself is associated with endothelial dysfunction, altered baroreceptor sensitivity, and heightened vascular reactivity, the hemodynamic response to different intubation techniques in this subset of patients may differ from the general population [7]. Another consideration in the hemodynamic response to intubation is the duration of the laryngoscopy attempt. Prolonged laryngoscopy times have been associated with greater sympathetic activation and more pronounced cardiovascular effects [7].

While video laryngoscopy often improves the glottic view, it may also prolong intubation time in

inexperienced users, potentially negating any hemodynamic benefits. Therefore, evaluating both the intubation time and hemodynamic changes is essential when comparing direct and video laryngoscopy in hypertensive patients [8].

Additionally, the choice of blade design in video laryngoscopy may influence hemodynamic outcomes. The Macintosh blade of the video laryngoscope allows for both direct and indirect laryngoscopy, providing anesthesiologists with greater flexibility during intubation [9].

Unlike hyperangulated blades, which require specific techniques and may prolong intubation times, the Macintosh blade maintains a familiar approach while potentially reducing the force required for laryngeal exposure. Whether this results in reduced hemodynamic perturbations compared to conventional Macintosh direct laryngoscopy remains an area of active investigation [8].

It is also important to consider the pharmacologic strategies used to mitigate hemodynamic fluctuations during intubation. Various agents, including opioids, beta-blockers, calcium channel blockers, and lidocaine, have been used to blunt the sympathetic response. However, excessive pharmacologic suppression may lead to hypotension, especially in elderly or frail hypertensive patients [10].

An ideal intubation technique should minimize the need for additional pharmacologic intervention while maintaining hemodynamic stability. Comparing the two laryngoscopy techniques in hypertensive patients may provide insights into optimizing anesthesia protocols for this population [11].

Furthermore, patient comfort and postoperative outcomes should also be considered when evaluating intubation techniques. Hemodynamic instability during induction has been associated with postoperative complications, including myocardial infarction and stroke [15].

If video laryngoscopy with a Macintosh blade demonstrates superior hemodynamic stability, its routine use in hypertensive patients could contribute to better perioperative outcomes. However, potential drawbacks such as equipment availability, cost, and the learning curve associated with video laryngoscopy must also be weighed against its benefits [11].

Given these considerations, the present study aims to compare the hemodynamic responses of orotracheal intubation in hypertensive patients using direct laryngoscopy with a Macintosh blade versus video laryngoscopy with a Macintosh blade. By focusing on this high-risk population, we seek to determine whether video laryngoscopy provides a significant advantage in attenuating cardiovascular stress during intubation [15].

This research may contribute to refining airway management strategies for hypertensive patients,

enhancing both safety and procedural efficiency in anesthesia practice [12].

In conclusion, orotracheal intubation remains a critical intervention with significant hemodynamic implications, particularly in patients with a history of hypertension. While video laryngoscopy has shown promise in reducing airway manipulation and improving glottic visualization, its impact on hemodynamic stability compared to conventional direct laryngoscopy remains an open question. Through a focused investigation, this study aims to provide valuable insights into optimizing airway management for hypertensive patients, ultimately improving perioperative safety and outcomes.

Material and methods

Study design: The present study is a randomized, double-blind, and prospective clinical trial conducted in 2024, involving patients undergoing general anesthesia who required endotracheal intubation, admitted to Shohada Hospital.

Inclusion Criteria

- Patient consent
- Diagnosis of hypertension
- Adequate control of the patient's hypertension within the past year
- Use of antihypertensive medication on the day of surgery, or as per routine
- Age between 18 and 60 years
- Equal gender ratio

Exclusion Criteria

- Patients under 18 years
- Any comorbidities besides hypertension
- Inadequate medication control
- Patients with low heart rate
- Patients on medications that increase blood pressure
- Emergency cases
- Patients with Mallampati scores of 3 or 4
- Patients with a history of difficult intubation

Sampling Method: This study used convenience sampling, where 360 patients who met the inclusion/exclusion criteria were selected and enrolled in the study through a complete enumeration approach.

Sample Size: To estimate the sample size, a sample size calculation formula was used, taking into account previous studies (12) and their findings. Based on statistical power analysis ($\alpha = 0.05$, $\beta = 0.20$), the sample size was determined to be 56, with 60 patients considered to increase the study's power.

Randomization and Blinding: Upon entry into the study, patients were randomly assigned into two

groups of 30 each using the online software WWW.Randomize.org. Initially, two groups were defined, and each eligible patient was enrolled into one of the groups using this online tool. Since the anesthesiologist performing the procedure was aware of the method used, blinding could not be achieved for them. However, the thesis intern, who recorded the outcomes of the study, and the statistical consultant, who performed the data analysis, were blinded to the group assignments and the type of drug administered, ensuring the study remained double-blinded.

Study Procedure: All patients fasted for one night and were restricted from consuming clear liquids 2-3 hours prior to surgery. Upon entering the operating room, an intravenous cannula was placed and the patients received fluid therapy. Non-invasive monitoring of BP and HR was continuously recorded with a multi-purpose monitor. All patients underwent the same general anesthesia procedure. A specific data collection form was designed and completed for each patient, including the following information:

- Demographic data: age, gender
- Duration of anesthesia, duration of surgery
- Severity of hypertension, medication use, dosage, antihypertensive medication on the morning of the surgery
- History of previous hospitalizations due to hypertension
- Weight of the patient

The baseline values of BP and HR were recorded after a 5-minute stabilization period. BP and HR were then recorded immediately after induction, during intubation, and at 1-minute intervals for the first 5 minutes post-intubation. The intubation time, defined as the period from the end of manual ventilation with a face mask to the commencement of ventilation through the endotracheal tube, was recorded using a stopwatch. Patients who required more than one attempt for successful intubation were excluded from the data analysis.

To measure hemodynamic status, a single device was used for all patients. Additionally, confounding variables such as medication and the duration of hypertension were controlled, ensuring that the confounding variables were balanced between the two groups to minimize their impact on the results.

Data Analysis Method

Data including age, gender, comorbidities, and documented factors were entered into the SPSS 20 statistical software and initially tested for normal distribution. If the data followed a normal distribution, descriptive statistics (mean, median, standard deviation, and mode) were calculated. For data not following a normal distribution, the 25%-75% range and the median were reported. To assess the relationships between variables, linear

regression analysis was used. Comparisons between the two groups, for normally distributed data, were made using independent t-tests for continuous variables and chi-square tests for categorical variables. If the data did not follow a normal distribution, non-parametric tests such as the Kruskal-Wallis test were applied.

Ethical Considerations

- Ethical approval was obtained from the Regional Ethics Committee (IR.TBZMED.REC.1402.420) on 06/13/2024
- Registered in the Iranian Clinical Trials Registry (IRCT20190325043107N34)
- Permission obtained from the administration of Nikoukari Hospital for the research
- The research objectives were explained to participants
- Written informed consent was obtained from all participants

- Only reliable sources were used in writing the final thesis
- Honesty and integrity in presenting the results, and no manipulation of data to favor the research
- No misuse of collected data

Results

The average results obtained in two tables and four charts are presented below.

The average age of the participants in the study was 53.85 ± 5.97 years. The majority of the participants were male. The average height, weight, and body mass index (BMI) of the participants were 177.28 ± 12.41 cm, 88.96 ± 10.27 kg, and 31.89 ± 3.69 , respectively. A comparison of baseline variables between the two groups of participants showed no statistically significant differences. The comparison of baseline variables between the two study groups is presented in the table below.

Table 1: Comparison of baseline variables between study groups

Variable	Macintosh Group (N=30)	Video Laryngoscope Group (N=30)	P Value
Age	55.27 ± 14.5	52.96 ± 3.89	0.456
Height (cm)	175.96 ± 12.63	180.47 ± 12.23	0.637
Weight (kg)	89.12 ± 12.79	88.85 ± 3.26	0.556
BMI	30.89 ± 2.96	31.17 ± 3.96	0.743
Gender	17 males (56.66%)	16 males (53.33%)	0.759
	13 females (43.33%)	14 females (46.66%)	

The assessment of comorbidities in the study participants revealed that hypertension was the only comorbid condition. The most commonly used antihypertensive medication among participants was Losartan, and all patients were regularly taking their antihypertensive medication. The average left ventricular ejection fraction (LVEF) in the participants was $45.17 \pm 5.27\%$. The average fasting

duration among the participants was 9.25 ± 1.19 hours.

A comparison of clinical data prior to surgery showed no significant statistical differences. The comparison of clinical status data between the two groups of participants is presented in the table below.

Table 2: Comparison of clinical status data between study groups

Variable	Macintosh Group (N=30)	Video Laryngoscope Group (N=30)	P Value
Duration of Laryngoscopy (min)	29.29 ± 5.69	23.56 ± 3.56	0.123
Left Ventricular Ejection Fraction (%)	44.29 ± 5.63	45.96 ± 5.14	0.756
Fasting Duration (hours)	9.02 ± 1.29	9.56 ± 1.33	0.439
Common Medication Used	Losartan: 14 (46.67%)	Losartan: 14 (46.67%)	0.814
	Losartan-HCT: 10 (33.33%)	Losartan-HCT: 11 (36.67%)	
	Captopril: 6 (20%)	Captopril: 5 (16.67%)	

It was observed that, in the Macintosh group, the heart rate increased significantly more than in the video laryngoscope group in the first minute post-intubation ($P = 0.025$). At other time points, the heart rate in the Macintosh group was non-significantly higher than in the video laryngoscope group.

Diastolic blood pressure (DBP) in the Macintosh group was significantly higher than in the video laryngoscope group at all post-intubation time points ($P < 0.05$). The changes in DBP over time in the Macintosh group showed significantly more

instability compared to the video laryngoscope group ($P = 0.014$).

Systolic blood pressure (SBP) in the Macintosh group was significantly higher than in the video laryngoscope group at all post-intubation time points ($P < 0.05$). The changes in SBP over time in the Macintosh group also showed significantly more instability compared to the video laryngoscope group ($P = 0.029$).

The mean arterial pressure (MAP) in the Macintosh group was significantly higher than in the video laryngoscope group at all post-intubation time points ($P < 0.05$). The changes in MAP over time in the Macintosh group showed significantly more instability compared to the video laryngoscope group ($P = 0.048$).

Discussion

This clinical trial aimed to compare the hemodynamic responses during tracheal intubation using the Macintosh laryngoscope and the video laryngoscope in hypertensive patients undergoing general anesthesia. The results of the study revealed several important findings regarding heart rate, blood pressure, and overall hemodynamic stability between the two groups [9].

The baseline characteristics of the participants were similar between the groups, including age, gender distribution, BMI, and the use of antihypertensive medications, confirming that the two groups were comparable at the outset of the study. The participants' hypertension, which was the only comorbid condition, was well controlled with regular medication [18], predominantly losartan, which was consistent across both groups. This controlled environment allowed for an accurate assessment of the hemodynamic changes associated with the intubation procedure itself, without the confounding effects of poorly controlled blood pressure [10].

The primary objective of this study was to investigate the hemodynamic responses, specifically the heart rate and blood pressure changes during intubation. The results demonstrated that in the Macintosh group, the heart rate immediately after intubation was significantly higher than in the video laryngoscope group.

This finding is consistent with previous studies suggesting that the traditional Macintosh laryngoscope, due to its more invasive technique and potentially more difficult intubation process, may trigger a greater sympathetic response, leading to a faster increase in heart rate. The video laryngoscope, on the other hand, may offer a more controlled and less traumatic intubation process, resulting in less stimulation of the autonomic nervous system and a more stable heart rate post-intubation [17]. These results underscore the potential benefit of video laryngoscopy, particularly in patients with pre-

existing cardiovascular conditions where minimizing stress responses is crucial [11].

Moreover, the analysis of diastolic blood pressure (DBP) revealed significantly higher values in the Macintosh group after intubation at all-time points. This suggests that the intubation technique with the Macintosh laryngoscope may induce a more pronounced increase in peripheral vascular resistance, which could explain the higher DBP in this group [19-21]. In contrast, the video laryngoscope group exhibited more stable diastolic blood pressure, likely due to the smoother and more controlled nature of the intubation. This difference in hemodynamic response could be of clinical significance, especially in hypertensive patients, as a rapid and significant increase in blood pressure can increase the risk of cardiovascular events such as stroke or myocardial infarction [12].

In line with the findings related to DBP, systolic blood pressure (SBP) and mean arterial pressure (MAP) were also significantly higher in the Macintosh group post-intubation. These results further highlight the more pronounced cardiovascular response in the group undergoing Macintosh intubation [22-24]. The higher levels of SBP and MAP observed in this group suggest that the increased sympathetic stimulation associated with the Macintosh laryngoscopy may lead to greater vasoconstriction and elevated cardiac output. On the other hand, the video laryngoscope group showed more stable SBP and MAP, which could indicate that the technique induces less sympathetic activation, offering a more favorable hemodynamic profile [13].

These findings are important when considering the safety of hypertensive patients undergoing general anesthesia. Hypertensive patients, particularly those with poorly controlled blood pressure, are at higher risk for cardiovascular complications during surgery [25-27]. Therefore, minimizing stress responses during intubation and maintaining stable hemodynamics are essential goals. Video laryngoscopy, which appears to cause less hemodynamic fluctuation, may be a better choice for these patients, particularly for those with a history of cardiovascular disease [8].

However, the study does have some limitations. While the sample size was adequate for detecting significant differences in hemodynamic variables, the generalizability of the findings may be limited by the fact that all participants were hypertensive and undergoing elective surgery [28-30]. The results may not apply to patients with other comorbid conditions or those undergoing emergency procedures, where the intubation process could be more challenging, and the hemodynamic responses might differ [31-33]. Additionally, the study was conducted at a single center, which limits the diversity of the patient population and the external validity of the results [15].

Another limitation of this study was the lack of measurement of other factors that may influence hemodynamics during intubation, such as the experience of the anesthesiologist or the presence of difficult airway predictors [34-36]. Although we controlled for several potential confounders, including the use of the same anesthesia protocol, the experience of the clinician performing the intubation may have played a role in the observed hemodynamic responses. Furthermore, this study did not assess long-term outcomes such as post-operative recovery or complications related to intubation techniques, which could provide further insights into the practical implications of choosing one technique over the other [37-39].

Conclusion

In conclusion, the results of this study suggest that video laryngoscopy may offer a more favorable hemodynamic profile in hypertensive patients undergoing general anesthesia, with less fluctuation in heart rate, blood pressure, and mean arterial pressure compared to the traditional Macintosh laryngoscope. These findings highlight the potential advantages of video laryngoscopy in reducing stress responses during intubation, particularly in patients with cardiovascular concerns. Future studies with larger and more diverse patient populations, including those with other comorbidities and emergency situations, are needed to confirm these findings and explore the broader applicability of video laryngoscopy in clinical practice.

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