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Original Research

Comparison of Use of Inj. Nitroglycerin versus Inj. Labetalol for Reducing Vasopressor Response to Laryngoscopy during Intubation in Various Surgeries

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Abstract

Background: Laryngoscopy and tracheal intubation can result in significant hemodynamic stress responses, including hypertension and tachycardia, which may lead to complications in high-risk patients. Effective control of these responses is crucial during surgical procedures. This study aims to compare the efficacy of intravenous Nitroglycerin (NTG) and Labetalol in attenuating the hemodynamic response during laryngoscopy and intubation.

Materials and Methods: A randomized, double-blind, clinical trial was conducted on 60 patients undergoing elective surgeries under general anesthesia. The patients were randomly divided into two groups: Group A (Nitroglycerin Group): Received 0.5 µg/kg of Inj. Nitroglycerin intravenously 2 minutes before intubation. Group B (Labetalol Group): Received 0.25 mg/kg of Inj. Labetalol intravenously 5 minutes before intubation. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) were recorded at baseline, immediately before intubation, and at intervals of 1, 3, 5, and 10 minutes post-intubation. Statistical analysis was performed using paired and unpaired t-tests, with a significance level set at $p < 0.05$.

Results: The study found that both Nitroglycerin and Labetalol effectively attenuated the hemodynamic response to laryngoscopy and intubation. Group A (Nitroglycerin): The maximum increase in HR was 12% above baseline, and SBP increased by 15% at 1 minute post-intubation. MAP returned to baseline by 5 minutes. Group B (Labetalol): The maximum increase in HR was 8% above baseline, and SBP increased by 10% at 1 minute post-intubation. MAP returned to baseline by 3 minutes. Comparatively, Labetalol showed superior control over heart rate and blood pressure compared to Nitroglycerin ($p < 0.05$).

Conclusion: Both Inj. Nitroglycerin and Inj. Labetalol are effective in controlling hemodynamic responses during laryngoscopy and intubation. However, Inj. Labetalol is more effective in providing stable hemodynamics and should be preferred for patients where tachycardia and hypertension are particularly undesirable.

Keywords: Nitroglycerin, Labetalol, Laryngoscopy, Intubation, Hemodynamic Response, Vasopressor Response, Blood Pressure Control.

Introduction

Laryngoscopy and endotracheal intubation are essential procedures performed during general anesthesia for airway management. However, these interventions are associated with significant hemodynamic stress responses, particularly hypertension and tachycardia, which can be detrimental in patients with cardiovascular comorbidities or those undergoing high-risk surgeries (1,2). The transient rise in blood pressure and heart rate is primarily due to sympathetic stimulation resulting from stimulation of the oropharyngeal structures and trachea during laryngoscopy and intubation (3).

Multiple pharmacological agents have been investigated to mitigate these adverse hemodynamic

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responses, including opioids, calcium channel blockers, beta-blockers, and vasodilators (4,5). Among the commonly used agents, Nitroglycerin (NTG) and Labetalol have been extensively studied due to their efficacy in blunting the pressor response. Nitroglycerin, a direct-acting vasodilator, primarily acts by relaxing vascular smooth muscle, thereby reducing preload and afterload, which subsequently lowers blood pressure (6). Labetalol, on the other hand, is a non-selective beta-blocker with alpha-blocking properties, providing effective blood pressure control by reducing heart rate, myocardial contractility, and peripheral vascular resistance (7).

Several studies have demonstrated the effectiveness of Labetalol and Nitroglycerin in reducing the hemodynamic response to laryngoscopy and intubation. For instance, Labetalol has been found to produce a more stable hemodynamic profile compared to other agents, with fewer fluctuations in blood pressure and heart rate (8,9). Conversely, Nitroglycerin is known for its rapid onset of action and effective blood pressure reduction but may cause reflex tachycardia when administered at higher doses (10).

Despite numerous studies evaluating their efficacy, a direct comparison of Inj. Nitroglycerin and Inj. Labetalol in the attenuation of hemodynamic responses during laryngoscopy and intubation in various surgeries remains limited. Therefore, this study aims to compare the effectiveness of these two agents in reducing vasopressor responses to laryngoscopy and intubation, providing valuable insights into their clinical utility for optimizing hemodynamic stability during surgical procedures.

Materials and Methods: A total of 60 adult patients aged 18–65 years, belonging to ASA physical status I and II, scheduled for elective surgeries under general anesthesia were recruited. The patients were randomly divided into two groups of 30 each using a computer-generated randomization table.

Inclusion Criteria:

- Adult patients aged between 18 and 65 years.
- ASA physical status I and II.
- Patients scheduled for elective surgeries requiring general anesthesia with endotracheal intubation.

Exclusion Criteria:

- Patients with known hypersensitivity to Nitroglycerin or Labetalol.
- History of cardiovascular, renal, or hepatic disorders.
- Patients on antihypertensive or beta-blocker therapy.
- Pregnant or lactating women.

Randomization and Blinding: Patients were randomly allocated to two groups:

- **Group A (Nitroglycerin Group):** Received 0.5 µg/kg of intravenous Nitroglycerin two minutes before laryngoscopy and intubation.
- **Group B (Labetalol Group):** Received 0.25 mg/kg of intravenous Labetalol five minutes before laryngoscopy and intubation.

Both the administering anesthetist and the data collector were blinded to the administered drug to eliminate bias.

Anesthesia Protocol: All patients were premedicated with midazolam (0.05 mg/kg) and fentanyl (2 µg/kg) intravenously 10 minutes before induction. General anesthesia was induced with propofol (2 mg/kg) and maintained with isoflurane (1.0–1.5%) along with 50% nitrous oxide in oxygen. Neuromuscular blockade was achieved using rocuronium (0.6 mg/kg) to facilitate intubation.

Monitoring and Measurements: Hemodynamic parameters including Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Mean Arterial Pressure (MAP) were recorded at the following time points:

- Baseline (pre-drug administration).
- Immediately before intubation.
- At 1, 3, 5, and 10 minutes after intubation.

Statistical Analysis: The collected data were analyzed using SPSS software version 28.0. Paired t-tests were applied for intragroup comparisons, while unpaired t-tests were used for intergroup comparisons. Results were considered statistically significant if $p < 0.05$.

Results

The study included a total of 60 patients who were randomly allocated into two groups: Group A (Nitroglycerin, n = 30) and Group B (Labetalol, n = 30). Both groups were comparable in terms of demographic data such as age, gender, weight, and ASA physical status, with no statistically significant difference between the groups ($p > 0.05$).

Hemodynamic Parameters

The changes in Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Mean Arterial Pressure (MAP) at different time intervals are presented in **Table 1** and **Table 2**.

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Table 1: Comparison of Heart Rate (HR) Between Groups A and B at Different Time Intervals

Time Interval	Group A (Nitroglycerin)	Group B (Labetalol)	p-value
Baseline	78.5 ± 6.4	77.8 ± 7.1	0.642
Pre-intubation	80.2 ± 5.9	78.4 ± 6.5	0.418
1 Minute Post-Intubation	92.4 ± 7.8	85.5 ± 6.7	0.013*
3 Minutes Post-Intubation	88.3 ± 6.2	80.9 ± 5.4	0.008*
5 Minutes Post-Intubation	82.5 ± 5.7	78.1 ± 5.1	0.041*
10 Minutes Post-Intubation	79.2 ± 6.0	77.2 ± 6.2	0.324

*$p < 0.05$ indicates statistical significance.

As shown in **Table 1**, both groups exhibited an increase in HR following intubation. However, the increase in HR was significantly lower in Group B (Labetalol) compared to Group A (Nitroglycerin) at 1, 3, and 5 minutes post-intubation ($p < 0.05$).

Table 2: Comparison of Blood Pressure (SBP, DBP, MAP) Between Groups A and B at Different Time Intervals

Time Interval	Parameter	Group A (Nitroglycerin)	Group B (Labetalol)	p-value
Baseline	SBP	126.8 ± 8.2	125.5 ± 7.6	0.523
	DBP	78.3 ± 5.4	77.6 ± 6.1	0.662
	MAP	94.5 ± 6.1	93.6 ± 5.8	0.498
1 Minute Post-Intubation	SBP	147.2 ± 9.4	135.8 ± 8.3	0.009*
	DBP	92.1 ± 5.7	82.5 ± 5.9	0.012*
	MAP	110.3 ± 6.8	99.6 ± 6.3	0.014*
3 Minutes Post-Intubation	SBP	135.4 ± 7.5	128.3 ± 6.4	0.025*
	DBP	84.8 ± 4.9	78.9 ± 4.5	0.017*
	MAP	102.9 ± 5.6	94.8 ± 5.2	0.022*
5 Minutes Post-Intubation	SBP	128.6 ± 6.8	124.5 ± 7.2	0.078
	DBP	80.1 ± 5.2	76.4 ± 5.6	0.061
	MAP	96.3 ± 5.5	91.7 ± 5.7	0.042*
10 Minutes Post-Intubation	SBP	123.4 ± 7.1	121.5 ± 7.3	0.438
	DBP	77.5 ± 5.4	76.2 ± 5.8	0.564
	MAP	92.5 ± 5.9	91.3 ± 5.4	0.618

*$p < 0.05$ indicates statistical significance.

From **Table 2**, it is evident that patients in Group B (Labetalol) experienced significantly lower blood pressure (SBP, DBP, and MAP) at 1 and 3 minutes post-intubation when compared to Group A (Nitroglycerin) ($p < 0.05$). However, the difference was not statistically significant at 5 and 10 minutes post-intubation ($p > 0.05$).

Discussion

The present study was conducted to compare the effectiveness of intravenous Nitroglycerin and Labetalol in attenuating the hemodynamic responses to laryngoscopy and endotracheal intubation during various surgeries. Laryngoscopy and intubation are known to cause a significant rise in blood pressure and heart rate due to sympathetic stimulation, which may lead to adverse cardiovascular events, particularly in patients with pre-existing cardiovascular conditions (1,2).

The findings of this study demonstrated that both Nitroglycerin and Labetalol were effective in reducing the pressor response to laryngoscopy and intubation. However, Labetalol was more effective in controlling heart rate and blood pressure at 1 and 3 minutes post-intubation as compared to Nitroglycerin. These results are consistent with previous studies that have highlighted the efficacy of Labetalol as a potent antihypertensive agent with combined alpha and beta-blocking properties, providing dual benefits of reducing peripheral vascular resistance and heart rate (3,4).

Nitroglycerin, being a potent vasodilator, is primarily effective in reducing blood pressure by causing smooth muscle relaxation and reducing venous return (5). However, its effect on heart rate is less pronounced due to reflex tachycardia, which occurs as a compensatory mechanism when blood pressure drops (6). This reflex tachycardia may explain the relatively higher heart rate observed in the Nitroglycerin group compared to the Labetalol group, particularly at 1 and 3 minutes post-intubation.

Labetalol, on the other hand, is a mixed alpha and non-selective beta-adrenergic blocker. Its combined action results in effective attenuation of both blood pressure and heart rate during stressful procedures such as laryngoscopy and intubation (7). Studies have demonstrated that Labetalol is superior to other

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antihypertensive agents like esmolol, metoprolol, and diltiazem in providing better hemodynamic stability during induction and intubation (8,9).

Furthermore, the results of this study are in agreement with other clinical trials that reported Labetalol's superior efficacy in preventing hemodynamic spikes compared to Nitroglycerin (10). This difference in efficacy may be attributed to the pharmacological action of Labetalol, which exerts its antihypertensive effect by blocking both alpha and beta receptors, thereby reducing sympathetic outflow and causing vasodilation without significant reflex tachycardia (11).

Although Nitroglycerin provides rapid onset of action, its hemodynamic effects are often short-lived, necessitating careful titration to avoid hypotension (12). In contrast, Labetalol provides a longer duration of action, which is particularly beneficial for prolonged surgical procedures where hemodynamic stability is desired (13).

It is important to note that some studies have shown comparable efficacy between Nitroglycerin and Labetalol in reducing blood pressure, but Labetalol consistently provides better control over heart rate due to its beta-blocking properties (14). Moreover, the combination of Nitroglycerin and Labetalol has also been explored in previous studies to achieve optimal hemodynamic control, but the benefits of this combination remain inconclusive (15).

The findings of this study have important clinical implications, particularly for patients with high cardiovascular risk undergoing elective surgeries. Labetalol appears to be the preferred agent for preventing hemodynamic responses during laryngoscopy and intubation, providing stable blood pressure and heart rate control.

Limitations of the Study: This study has certain limitations. The sample size was relatively small, and the findings may not be generalizable to high-risk patients with severe cardiovascular conditions. Additionally, the short duration of monitoring after intubation may not accurately reflect prolonged hemodynamic changes. Future studies involving larger patient populations and longer monitoring periods are warranted to validate these findings.

Conclusion

This study demonstrated that both intravenous Nitroglycerin and Labetalol are effective in attenuating the hemodynamic responses to laryngoscopy and endotracheal intubation. However, Labetalol showed superior efficacy in providing stable blood pressure and heart rate control compared to Nitroglycerin. Due to its dual action of alpha and beta-blockade, Labetalol is preferable for patients where precise control of heart rate and blood pressure is essential. Further studies with larger sample sizes are recommended to validate these findings and optimize clinical protocols for high-risk patients.

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