ORIGINAL ARTICLE

Preoperative Lignocaine Nebulization for Attenuation of the Pressor Response of Laryngoscopy and Tracheal Intubation in Patients Undergoing Laparoscopic Cholecystectomy Under General Anesthesia

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ABSTRACT

Introduction: Laryngoscopy and intubation during laparoscopic cholecystectomy under general anesthesia can cause a pressor response, resulting in hemodynamic instability. Preoperative lignocaine nebulization provides topical anesthesia by inhibiting sodium channels and may offer better mucosal coverage than intravenous administration. **Aims:** To assess the effect of lignocaine nebulization on pressor response, hemodynamic stability, and related complications. **Methods:** This double-blinded comparative study was conducted from August to December 2024, involving 100 patients undergoing elective surgery under general anesthesia with physical status score I or II (American Society of Anesthesiologists). Patients were randomized into two groups for nebulization: Group A (n=50) received 2% lignocaine (3 mg/kg, volume adjusted with saline), while Group B (n=50) received an equivalent volume of 0.9% normal saline. Parameters analyzed included age, gender, weight, ASA physical status, SpO2, heart rate and mean arterial pressure. Statistical analysis was performed using Student's t-test and Chi-square test; $p<0.05$ was considered significant. **Results:** Both groups were comparable in terms of age, gender, physical status and mean duration of surgery. In group A, the baseline Heart Rate was 89.34 ± 12.12 per minute while in group B 88.26 ± 10.98 per minute. Two minutes after intubation, it increased and started declining from the 4th minute in both the groups. However, there were significant statistical difference between two groups at 2 and 4 minutes respectively (p = 0.001 and 0.038). Mean arterial pressure (MAP) also rose in both groups at 2 minutes, but the increase was significantly greater in group B (p=0.001). This difference remained significant at 4 minutes (p=0.001), with no significant variation observed from the 6th minute onward. **Conclusion:** Preoperative lignocaine nebulization effectively blunts the pressor response to laryngoscopy and intubation, enhancing hemodynamic stability and perioperative safety.

Keywords: Hemodynamic, Laryngoscopy, Lignocaine nebulization, Pressor response, Intubation

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INTRODUCTION

Laparoscopic cholecystectomy is a commonly performed surgical procedure, typically conducted under general anesthesia with endotracheal intubation. However, laryngoscopy and tracheal intubation can lead to a sympathetic response known as the pressor response, characterized by an increase in blood pressure and heart rate. This response can be detrimental, especially in patients with cardiovascular disease or hypertension. Forbes and Dally reported a case of acute ischemia even in a previously healthy, normotensive patient whose blood pressure reached 190/130 mmHg,[1] indicating the importance of suppressing pressor response. Attenuation of pressor responses could be possible either by deepening the plane of anesthesia[2] or by the use of drugs, or by using advanced airway devices.[3] The attenuation of pulse and blood pressure fluctuations may be attributed to lignocaine's local anesthetic action, which inhibits sodium channels and reduces afferent neuronal transmission from the oropharynx and larynx, thereby blunting sympathetic nervous system activation.[4,5] This study was done to determine whether preoperative lignocaine nebulization can effectively attenuate the pressor response of laryngoscopy and tracheal intubation and to assess its impact on hemodynamic stability, postoperative complications in patients under-

going laparoscopic cholecystecomy under general anesthesia.

METHODS

This Hospital based prospective, double-blinded comparative study was carried out in the Department of Anesthesiology, Nepalgunj Medical College and Teaching Hospital, Kohalpur, Nepal, from August 2024 to December 2024 after approval from the Institutional Review Committee. Patients aged 18–65 years of any gender, classified as American Society of Anesthesiologists (ASA) I or II, and scheduled for elective laparoscopic cholecystectomy under general anesthesia were included after obtaining written informed consent. Exclusion criteria included: known allergy to lignocaine, hypertension, diabetes mellitus, COPD, cardiovascular, renal, hepatic, or neurological diseases, or an abnormal coagulation profile. The sample size was calculated with an α error of 5% and β error of 20%[6] resulting in 100 patients. Patients (N = 100) were randomly assigned to one of two groups (n = 50 per group) using a sealed opaque envelope method.

Group A (Lignocaine group): Nebulized with 2% lignocaine at 3 mg/kg (total volume adjusted with saline) for 10 minutes before induction using a fitting face mask with Nebulizer Nebufish model of Explore Medical Accessories.

Group B (NS group): Nebulized with an equivalent volume of 0.9% normal saline.

The patient and the anesthesiologist recording the outcomes were blinded to group allocation. A separate anesthesiologist or nurse, not involved in the study, prepared and administered the study drugs. All the patients included for the study were admitted to the hospital day before surgery. They all underwent complete pre-anaesthetic evaluation including detailed history taking, physical examination and routine pre-operative investigations. All the patients fasted for 6 hours were received and identified in the operation theater on the day of surgery. An intravenous line was established with an 18G intravenous cannula in a large vein on the dorsum of the hand or forearm. All patients were attached with standard monitors with heart rate (HR), non-invasive blood pressure (NIBP), respiratory rate (RR), arterial hemoglobin oxygenation by pulse oximeter (SPO2) and electrocardiography (ECG) before the procedure was started and recorded. All patients were pre-oxygenated with 100% oxygen for 3 minutes and midazolam in the dose of 2mg and fentanyl 2mcg/kg was given as well. Anaesthesia was induced using Propofol injection in the dose of 1 mg/kg. Endotracheal intubation was facilitated using Vecuronium in the dose of 0.08mg/kg IV. Laryngoscopy and endotracheal intubation was done with Machintosh laryngoscope. Anesthesia was maintained with 100% oxygen, Isoflurane (1-2%), and intermittent doses of vecuronium.

Following parameters were recorded:

•Baseline parameters and Changes in HR, SBP, DBP and mean arterial pressure at 1, 2, 4 upto 10 min after intubation

•Occurrence of Arrhythmias noted if any during laryngoscopy and intubation.

After the end of the surgery, residual neuromuscular blockade was antagonized with neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg and endotracheal tube was removed once the patient resumed spontaneous breathing.

Statistical Analysis

Data thus recorded and collected were analyzed by standard statistical tests such as Chi square test and Students t-test with SPSS version 20. The p value < 0.05 were considered statistically significant.

RESULTS

Both groups were comparable with regards to age, gender, weight, ASA physical status, mean duration of surgery. There was no statistically significant difference between groups (p > 0.05). (Table I)

Variables	Group A	Group B	p-value
Age (years)	41.80 ± 15.29	44.12 ± 14.57	0.439
Gender			
Male	17 (34)	12 (24)	0.378
Female	33 (66)	38 (76)	
Weight (Kg)	53.86 ±7.14	51.94±4.80	0.118
Physical Status			
ASA I	39 (78)	35 (70)	0.495
ASA II	11 (22)	15 (30)	
Duration of Surgery (min)	81.40 ±19.27	76±16.41	0.135

Table I: Study population demographic data

In group A, the baseline HR was 89.34 ± 12.12 bpm while in group B 88.26 ± 10.98 bpm. Two minute after intubation, it was increased and it started declining from the 4th minute in both the groups. However, there was significant statistical difference between two groups at 2 and 4 minutes respectively (p value of 0.001 and 0.038). Figure 1

Similar results were seen with Systolic, Diastolic and Mean Arterial Pressure. There was significant difference between the two groups (p value of 0.001 and 0.001) while using Students t-test in mean arterial pressure at 2 and 4 minutes after intubation. Figure 2

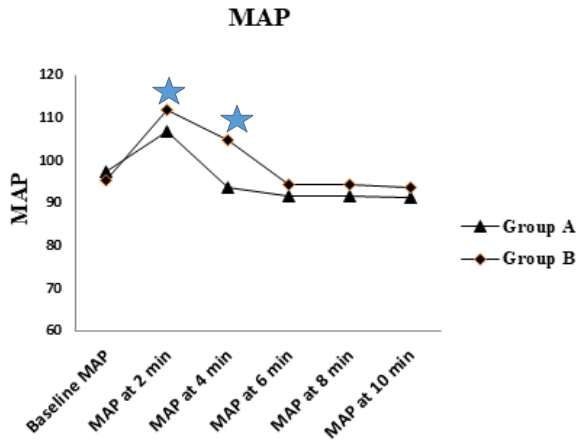

Figure 1: Mean Heart Rates (beats per min) of the two study groups at different time intervals

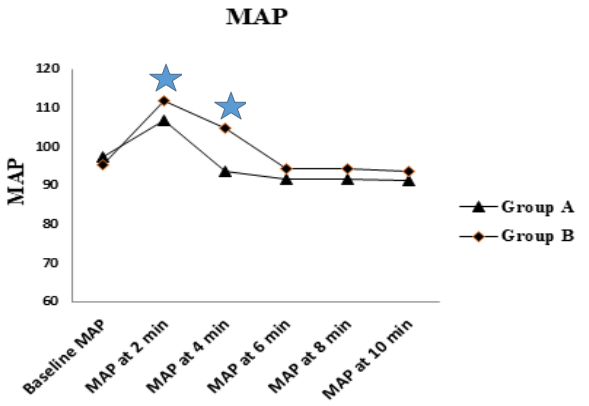

Figure 2: MAP (mmHg) of the two study groups at different time intervals

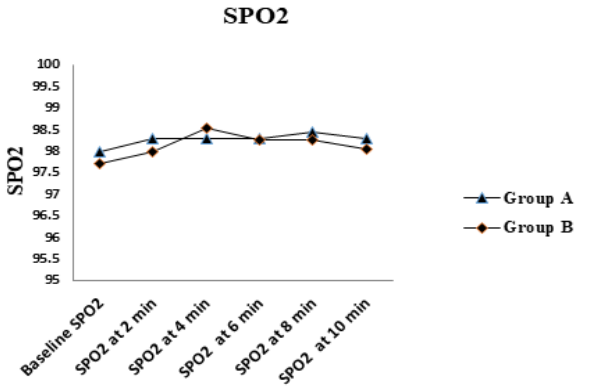

Figure 3: SPO2 of the two study groups at different time intervals

There was no significant difference between groups regarding SpO2 at all assessed times ($p > 0.05$) intraoperatively. Figure 3 In both groups, no any side effect or complication was observed.

DISCUSSION

Direct laryngoscopy and intubation are noxious stimuli that can provoke adverse cardiovascular and other system changes. It induces hemodynamic alterations within seconds, subsequently causing an elevation in heart rate and blood pressure upon tracheal intubation.[7] Hence, suppressing hypertensive responses during airway manipulation is a crucial prerequisite for proper general anesthesia. Lignocaine given by nebulization, has a good safety profile.[8] It can be easily administered non-invasively and is generally well tolerated. It has a rapid onset of action, a short duration, minimal side effects and is cost-effective.

We selected 10 ml of 2% lignocaine for nebulization in the patients. Woodruff et al conducted a study on awake fiber-optic intubation and observed that 2% and 4% nebulized lignocaine had similar haemodynamic responses to topicalization and airway manipulation. However, there was a delay in the return of airway reflexes in short duration surgeries with 4% concentration.[10] The dose of 10 ml was chosen in order to ensure comparability between two groups. It is suggested that 50% of the mists were lost around the patient's mouth during expiration and breath holding.[11]

We used continuous nebulization; therefore, the estimated loss of nebulized lignocaine was greater than 50%. In our study, patients were nebulized with 10 ml of 2% lignocaine using a standard gas-driven nebulizer, 15 minutes prior to attempting laryngoscopy. There was an increase in heart rate and mean arterial pressure at 2 and 4 minutes, which gradually declined below baseline from 6 minutes onward following intubation in both groups. The mean rise in heart rate and mean blood pressure were comparatively lesser in the nebulize group, which was statistically significant when compared to normal saline group. There were no episodes of bradycardia in any of our study groups.

Agrawal et al (2022)[12] conducted an observational study in 50 patients within the age group of 18-65 years undergoing elective surgery under general anaesthesia randomly allocated into two groups: Group L (n=25) nebulized with 5 ml lignocaine (2%) and Group C (n=25) nebulized with 5 ml normal saline, 15 minutes before surgery. Their study indicated a significant reduction in heart rate and mean arterial pressure in the lignocaine group compared to the control group at intubation 2, 5 and 10 minutes after intubation respectively further supporting the use of lignocaine nebulization in managing hemodynamic responses during intubation as highlighted by our study results.

Similarly, Nabil et al (2023)[13] conducted a randomized double blind study on 110 patients with severe preeclampsia who underwent caesarean delivery under general anaesthesia. They found that patients who received preoperative nebulization with 2% lignocaine (4.5 mg/kg, up to 400 mg) had significantly lower systolic blood pressure and heart rate at 1, 3 and 5 minutes after intubation compared to those who received normal saline. These findings were consistent with our study.

Another study by Baloch et al (2023)[14] included 90 patients and compared three groups: intravenous lignocaine, nebulized lignocaine, and saline. Both the intravenous and nebulized lignocaine groups had better control of heart rate and blood pressure during intubation than the saline group. Nebulized lignocaine was nearly as effective as the intravenous route.

Verma et al (2022)[15] also studied 94 patients undergoing head and neck surgery. One group received 4% lignocaine via nebulization, while the other received saline. The lignocaine group had a smaller rise in blood pressure and heart rate after intubation, with values returning to normal within 10 minutes.

In the current study we observed the most common ECG abnormality as Sinus Tachycardia. However, there were no any other arrhythmia and side effects observed in both the groups. All the patients were satisfied with the procedures they underwent. The occurrence of sinus arrhythmia as a minor side effect in both groups suggests that this rhythm disturbance may not be directly attributable to the intervention. Sinus arrhythmia, characterized by phasic variations in heart rate with respiration, is a common benign finding during anesthesia, often linked to vagal stimulation during laryngoscopy, mechanical ventilation, or pneumoperitoneum in laparoscopic procedures.[16,17]

While systemic lignocaine administration has been associated with arrhythmogenic effects at high doses (e.g.ventricular arrhythmias), lignocaine nebulization typically achieves lower plasma concentrations, minimizing such risks.[18,19] Studies by Kim et al (2020) and Gupta et al (2021) similarly reported sinus arrhythmia as a transient, hemodynamically insignificant event during intubation, unrelated to lignocaine use.[20,21]

The clinical implications of this study are significant, particularly in laparoscopic procedures where hemodynamic stability is critical in minimizing perioperative complications. The simplicity of nebulization makes it a practical option in resource-limited settings like ours.

LIMITATIONS

Limitations of this study includes it's lack of comparison with other pharmacological agents, such as opioids or beta-blockers, which are also used to attenuate pressor responses. Future studies should explore optimal dosing regimens in various other surgeries in different settings.

CONCLUSION

This study showed that the preoperative lignocaine nebulization represents an effective strategy to attenuate the hemodynamic stress response to laryngoscopy and intubation. Its integration into routine general anesthesia practice could enhance patient safety, particularly in high-risk populations.

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