Section: Anaesthesiology

Original Research Article

EVALUATION OF INTRAVENOUS DEXMEDETOMIDINE VERSUS INTRAVENOUS LIGNOCAINE IN ATTENUATION OF HEMODYNAMIC STRESS RESPONSE TO LARYNGOSCOPY AND ENDOTRACHEAL INTUBATION IN NORMOTENSIVE PATIENTS UNDERGOING ELECTIVE SURGERIES

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ABSTRACT

Background: This study evaluates the efficacy of intravenous Dexmedetomidine versus intravenous Lignocaine in attenuating the hemodynamic stress response to laryngoscopy and endotracheal intubation in normotensive patients undergoing elective surgeries. **Introduction:** Laryngoscopy and intubation can cause significant cardiovascular stress, leading to hypertension and tachycardia due to sympathetic activation. Dexmedetomidine, an α2 agonist, provides hemodynamic stability by suppressing catecholamine release and inducing sedation. Lignocaine, a local anesthetic, stabilizes neuronal membranes to attenuate the pressor response. Comparing these agents is essential for optimizing perioperative management and ensuring better hemodynamic control during surgical procedures.

Materials and Methods: This prospective, randomized study included 90 ASA I–II normotensive patients (18–50 years) undergoing elective surgery. Patients were divided into two groups: Group D received Dexmedetomidine (1 mcg/kg IV), and Group L received Lignocaine (1.5 mg/kg IV) before intubation. Hemodynamic parameters (HR, SBP, DBP, MAP, SpO_2) were recorded at baseline, pre-laryngoscopy, and at 1, 3, and 5 minutes post-intubation. Sedation levels were assessed using the Ramsay Sedation Scale, and adverse effects were monitored.

Results: Dexmedetomidine significantly reduced HR, SBP, DBP, and MAP post-intubation compared to Lignocaine ($p<0.001$), demonstrating superior efficacy in blunting the pressor response. It also provided deeper sedation (Ramsay score 3) without major adverse effects. In contrast, Lignocaine produced a milder attenuation of hemodynamic changes, making Dexmedetomidine a more effective choice for maintaining perioperative hemodynamic stability while requiring careful monitoring.

Conclusion: Dexmedetomidine is more effective than Lignocaine in attenuating the pressor response to intubation while offering superior sedation. It ensures better hemodynamic stability in normotensive patients but requires vigilant monitoring due to the risk of hypotension and bradycardia. Its dual benefits make it a preferable choice for controlled perioperative management in elective surgeries.

Keywords: Dexmedetomidine, Lignocaine, hemodynamic response, laryngoscopy, intubation, anesthesia, sedation, blood pressure.

INTRODUCTION

Laryngoscopy and endotracheal intubation are essential procedures for securing the airway during elective surgeries; however, they are known to induce significant hemodynamic stress responses. These responses manifest as transient but marked increases in blood pressure (hypertension) and heart rate (tachycardia), primarily due to sympathetic nervous system activation triggered by mechanical irritation of the larynx and trachea.[1] The resultant surge in catecholamines, including adrenaline and noradrenaline, contributes to these cardiovascular changes.[1]

Although transient, typically occurring within 30 seconds of intubation and lasting less than 10 minutes, these hemodynamic changes are generally well tolerated by healthy individuals. However, in patients with preexisting cardiovascular conditions such as hypertension, ischemic heart disease, or cerebrovascular disease, they may pose considerable risks.[2] The potential complications highlight the importance of effective management strategies to mitigate these responses.[3]

Various pharmacological agents have been explored to attenuate the hemodynamic stress response to laryngoscopy and intubation. Among them, intravenous Dexmedetomidine and intravenous Lidocaine have demonstrated promising results. Dexmedetomidine, the pharmacologically active d-isomer of medetomidine, is a highly selective alpha-2 adrenergic receptor agonist with sedative, anxiolytic, and analgesic properties. It inhibits catecholamine release, reducing sympathetic outflow and thereby decreasing both heart rate and blood pressure, promoting hemodynamic stability.[4] Dexmedetomidine's advantages include its minimal respiratory depression and reduction in anesthetic requirements, making it a valuable agent in perioperative settings. Studies have shown its effectiveness in blunting the cardiovascular response to intubation, solidifying its role in hemodynamic management during surgery.[5]

Lidocaine, a well-established amide local anesthetic, is also used intravenously to mitigate the stress response associated with intubation. It stabilizes neuronal membranes by inhibiting sodium ion influx, reducing neuronal excitability and nerve impulse conduction.[6] This mechanism not only provides local anesthesia but also blunts the sympathetic response to laryngoscopy and intubation. Intravenous Lidocaine effectively reduces the pressor response, leading to better-controlled blood pressure and heart rate levels, while its analgesic properties contribute to overall hemodynamic stability.[7]

A comparative evaluation of Dexmedetomidine and Lidocaine in normotensive patients undergoing elective surgeries is crucial for determining the most effective strategy for managing hemodynamic stress responses. Normotensive patients serve as an ideal baseline, as the absence of preexisting hypertension allows for a clearer assessment of each agent's efficacy.[8] Dexmedetomidine, by reducing sympathetic outflow through alpha-2 agonism, and Lidocaine, by stabilizing neuronal membranes and providing local anesthesia, represent two distinct but effective approaches to hemodynamic stabilization.[9] Further research is required to explore their long-term effects, potential side effects, and contraindications. Comparative studies across different patient populations and surgical procedures will offer deeper insights into their optimal use, ultimately enhancing patient safety and minimizing perioperative complications.[10]

This study aims to objectively compare the efficacy of Dexmedetomidine and Lidocaine in attenuating pressor responses during laryngoscopy and endotracheal intubation while evaluating any associated adverse effects.[11]

MATERIALS AND METHODS

A prospective randomized comparative study was conducted in the Department of Anesthesiology at a tertiary care institute over 18 months, including 90 ASA I and II patients aged 18-50 years undergoing elective surgeries. Patients were alternatively allocated into two groups: Group D (Dexmedetomidine 1 mcg/kg IV) and Group L (Lidocaine 1.5 mg/kg IV). Preoperative assessment included a detailed history, physical examination, and investigations. Standard anesthesia protocols were followed, with preoxygenation, induction using Propofol, neuromuscular blockade with Suxamethonium, and maintenance with isoflurane in oxygen-nitrous oxide. Hemodynamic parameters (HR, SBP, DBP, MAP, SpO2) were recorded at baseline, pre-laryngoscopy, and post-intubation at specific intervals. Adverse events like hypotension and bradycardia were managed accordingly. Sedation was assessed using the Ramsay Sedation Scale. Statistical analysis was performed using SPSS 25.0, employing t-tests, chi-square tests, and repeated measures ANOVA, with a p-value <0.05 considered significant. Ethical clearance was obtained, and informed consent was secured from all participant.

RESULTS

The present study was successfully conducted on 90 patients with no protocol deviations. All participants were cooperative throughout the study.

The age distribution of participants is presented in Table 1. The majority of participants in both groups were between 20-40 years, with 62.2% in the Lidocaine group and 77% in the Dexmedetomidine group. There was no significant difference in the age distribution between the groups ($p=0.411$). However, the mean age was significantly different, with Group L having a higher mean age (35.96 ±

8.49 years) compared to Group D (31.62 ± 9.23 years, p=0.023) (Table 1).

The gender distribution (Table 2) showed that both groups had a male predominance, with 75.6% in the Lidocaine group and 80% in the Dexmedetomidine group. There was no significant difference in gender distribution between the groups (Table 1).

The mean Body Mass Index (BMI) of the study participants (Table 3) showed that Group D had a slightly higher BMI (24.2 ± 1.40 kg/m²) than Group L (23.5 ± 1.56 kg/m²), but the difference was not statistically significant (p=0.169). [Table 1]

Regarding ASA classification (Table 4), most participants belonged to ASA Class I (68.9% in Group L and 75.6% in Group D), with no significant difference between the groups. [Table 1]

Table 1: Demographic and Clinical Characteristics of Study Participants

Variable	Category	Group L (n=45)	Group D (n=45)	Total (N=90)	p-value
Age Distribution (years)	<20	1 (2.22%)	2 (4.44%)	3 (3.33%)	0.411
	20-30	11 (24.44%)	18 (40.00%)	29 (32.22%)	
	30-40	17 (37.78%)	17 (37.78%)	34 (37.78%)	
	>40	16 (35.56%)	8 (17.78%)	24 (26.67%)	
Mean Age (years)	-	35.96 ± 8.49	31.62 ± 9.23	-	0.023
Gender	Female	11 (24.4%)	9 (20.0%)	20 (22.2%)	NS
	Male	34 (75.6%)	36 (80.0%)	70 (77.8%)	
Body Mass Index (BMI, kg/m²)	Mean BMI	23.55 ± 1.56	24.22 ± 1.39	-	0.169
ASA Category	I	31 (68.89%)	34 (75.56%)	65 (72.22%)	NS
	II	14 (31.11%)	11 (24.44%)	25 (27.78%)	

The baseline heart rate was comparable between the two groups (p=0.171). However, from pre-laryngoscopy through 0, 1, 3, and 5 minutes post-laryngoscopy, the Dexmedetomidine group showed a significantly greater reduction in heart rate compared to the Lidocaine group (p<0.001) (Figure 1).

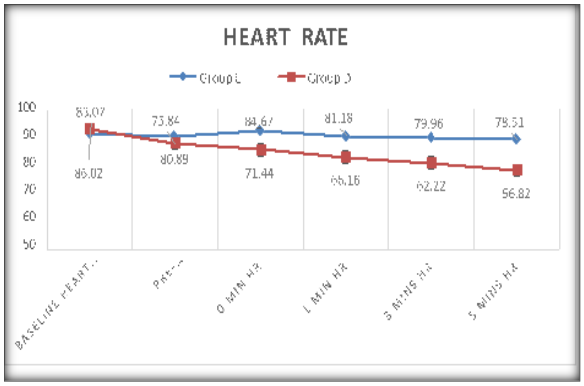

Figure 1: Mean Heart rate difference between the Lidocaine and Dexmedetomidine groups at different time interval

Baseline SBP showed no significant difference between groups (p=0.514). However, from pre-laryngoscopy to 5 minutes post-laryngoscopy, there was a significant reduction in SBP in both groups, with a more pronounced decrease in the Dexmedetomidine group (p<0.001). [Figure 2]

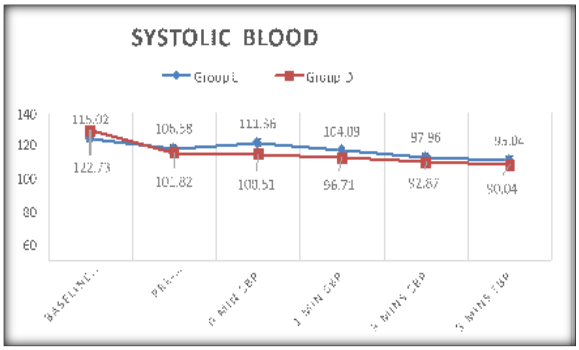

Figure 2: Mean Systolic Blood Pressure difference between the Lidocaine and Dexmedetomidine groups at different time interval

Similar trends were observed for DBP, with no significant difference at baseline (p=0.073). From pre-laryngoscopy to 5 minutes post-laryngoscopy, DBP showed a statistically significant reduction in both groups, with Group D experiencing a more significant decrease (p<0.001). [Figure 3]

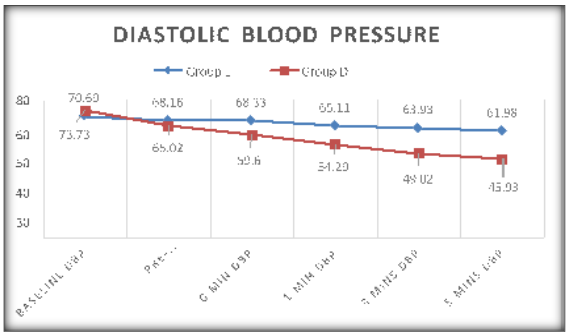

Figure 3: Mean Diastolic Blood Pressure difference between the Lidocaine and Dexmedetomidine groups at different time interval

Baseline MAP was significantly different between groups, with Group D having a lower MAP than

Group L (p=0.016). A significant reduction was observed in both groups from pre-laryngoscopy to 5 minutes post-laryngoscopy, with Group D showing a greater decline (p<0.001). [Figure 4]

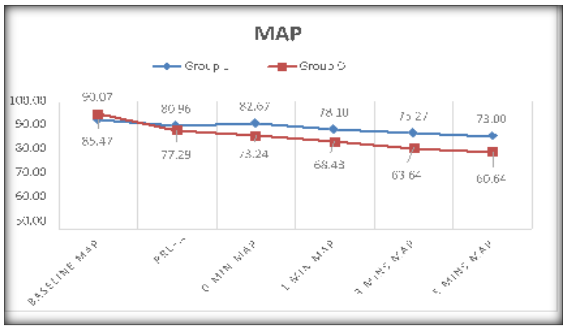

Figure 4: Mean MAP difference between the Lidocaine and Dexmedetomidine groups at different time interval

There was no significant difference in SpO2 levels at baseline, pre-laryngoscopy, or any of the follow-up intervals (p>0.05). Both groups maintained stable oxygen saturation levels throughout the intervention. [Figure 5]

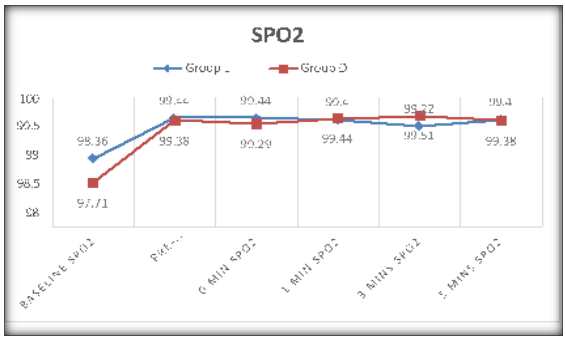

Figure 5: Mean Spo2 difference between the Lidocaine and Dexmedetomidine groups at different time interval

The distribution of Ramsay Sedation Scale Scores showed significant differences between groups (p<0.001). In the Lidocaine group, 73.3% had a score of 2, while in the Dexmedetomidine group, 88.9% had a score of 3. No patients in the Dexmedetomidine group had a score of 1, and no patients in the Lidocaine group had a score of 4. [Figure 6]

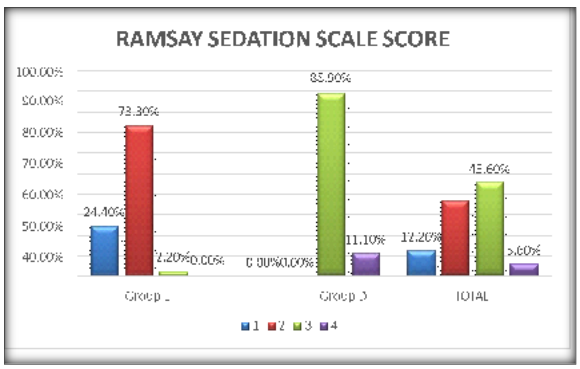

Figure 6: Distribution of study particiants between the groups based upon the Ramsay Sedation Scale Score

DISCUSSION

Laryngoscopy and endotracheal intubation are essential yet stressful procedures that induce significant hemodynamic responses due to sympathetic nervous system stimulation.[12] Dexmedetomidine, an α2 agonist, reduces catecholamine release, ensuring hemodynamic stability with sedation .Lidocaine, a local anesthetic, stabilizes neuronal membranes, mitigating stress responses.[13,14] This study compared the effectiveness of intravenous Dexmedetomidine (1 mcg/kg) and Lidocaine (1.5 mg/kg) in attenuating these responses during elective surgeries. The findings provide valuable insights into their efficacy, hemodynamic stability, and overall patient outcomes.

The results indicate that Dexmedetomidine is superior to Lidocaine in controlling heart rate, blood pressure (systolic, diastolic, and mean arterial pressure), and sedation levels. The significant reduction in heart rate observed in the Dexmedetomidine group aligns with findings from Prasad SR et al. (2015) and Niyogi et al. (2019), who reported similar reductions in heart rate with Dexmedetomidine compared to other agents.[15,16] This suggests that Dexmedetomidine effectively blunts the sympathetic response, providing enhanced hemodynamic stability post-laryngoscopy. Systolic and diastolic blood pressure reductions were also more pronounced in the Dexmedetomidine group than in the Lidocaine group. Studies by Niyogi et al. (2019) and Prasad SR et al. (2015) reported comparable reductions in systolic and diastolic blood pressure with Dexmedetomidine, reinforcing its role in mitigating pressor responses during intubation.[15,16] The mean arterial pressure (MAP) findings support the superiority of Dexmedetomidine, as a greater reduction was noted compared to Lidocaine. Sriramka B et al. (2023) and Singh G et al. (2019) similarly reported that Dexmedetomidine significantly lowers MAP, further validating our results.[17,18]

SpO2 levels remained stable in both groups, with no significant differences, indicating that neither drug adversely affected oxygen saturation. This finding aligns with previous studies by Prasad SR et al. (2015) and Sebastian B et al. (2017), which observed transient but non-significant fluctuations in SpO2 during intubation.[16,19] This highlights that both drugs can be safely administered without compromising oxygenation.

Sedation scores were significantly higher in the Dexmedetomidine group, with most patients scoring 2 on the Ramsay Sedation Scale. This outcome concurs with research by Niyogi et al. (2019) and Basantwani S et al. (2018), who observed similar sedation patterns in patients receiving Dexmedetomidine.[15,20] Enhanced sedation contributes to improved patient comfort and reduced

stress responses, further emphasizing Dexmedetomidine's advantages over Lidocaine.

The demographic analysis, including age, gender, BMI, and ASA grade, showed no significant differences between the groups, ensuring that hemodynamic variations were primarily due to the pharmacological effects rather than patient characteristics. These findings are consistent with studies by Gulabani et al. (2015), Singh G et al. (2019), and Niyogi et al. (2019), which also reported no significant demographic differences affecting outcomes.[21,18,12]

Overall, the findings suggest that Dexmedetomidine is more effective than Lidocaine in attenuating hemodynamic stress responses during laryngoscopy and intubation. It provides better control over heart rate, blood pressure, and sedation levels without compromising oxygenation. While both drugs are useful, Dexmedetomidine appears to offer superior stability, making it a preferable choice in perioperative settings. Further research with larger sample sizes and different surgical populations is recommended to optimize these findings and refine anesthesia protocols.

CONCLUSION

Intravenous Dexmedetomidine demonstrated superior efficacy over Lignocaine in attenuating hemodynamic stress responses to laryngoscopy and intubation in normotensive patients undergoing elective surgeries. Dexmedetomidine significantly reduced heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, providing enhanced hemodynamic stability. Additionally, it induced deeper sedation, which may benefit patients requiring moderate sedation. While mild bradycardia and hypotension were observed, they were manageable. Given its effectiveness in blunting the pressor response and providing sedation, Dexmedetomidine is a preferable choice over Lignocaine, particularly in patients where hemodynamic stability and sedation are critical considerations.

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