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Effect of Preoperative Dexmedetomidine Nebulisation on the Haemodynamic Response to Laryngoscopy and Intubation - An Observational Study

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Abstract: ***This observational study investigated the effect of preoperative dexmedetomidine nebulization on the hemodynamic response to laryngoscopy and intubation. Laryngoscopy and intubation trigger sympathetic discharge, leading to increased blood pressure and heart rate, necessitating attenuation through premedication and smooth induction. Dexmedetomidine nebulization was hypothesized to blunt this response due to its rapid absorption and bioavailability. The study aimed to evaluate the effects of dexmedetomidine nebulization on heart rate, blood pressure, and mean arterial pressure, as well as its propofol - sparing effect and potential adverse effects. Sixty patients (ASA I and II, 20 - 65 years old) were divided into two groups: Group A received normal saline nebulization, while Group B received 1mcg/kg dexmedetomidine nebulization 10 minutes before induction. Hemodynamic parameters were recorded pre - and post - nebulization, and at intervals post - intubation. Results showed significant blunting of hemodynamic responses and reduced propofol requirements in Group B, with no adverse effects. The study concludes that nebulized dexmedetomidine effectively attenuates the stress response to laryngoscopy and intubation without adverse effects.***

Keywords: Dexmedetomidine nebulization, hemodynamic response, laryngoscopy and intubation, stress response, propofol - sparing effect

1. Introduction

Laryngoscopy and endotracheal intubation are cornerstone procedures in anaesthesiology and critical care medicine, vital for securing the airway and enabling mechanical ventilation[1]. These interventions, while essential, often trigger a significant stress response in patients, characterized by acute hemodynamic changes including tachycardia, hypertension, and arrhythmias[2, 3]. Traditional approaches have included the use of opioids, betablockers, calcium channel blockers, and local anesthetics. In recent years, attention has increasingly turned to dexmedetomidine, a highly selective α2 - adrenergic agonist, known for its unique combination of sedative, anxiolytic, and analgesic properties[11]. Traditionally, dexmedetomidine has been administered intravenously. However, this route can be associated with side effects such as profound bradycardia and hypotension, particularly with rapid administration or in vulnerable patients[13]. Nebulization offers several potential advantages, including non - invasive administration, potentially fewer systemic side effects, and the possibility of achieving localized effects in the airways. Moreover, some studies indicate that this approach may reduce the requirements for other anaesthetic agents and improve intubation conditions[4, 15].

Present study aims to comprehensively evaluate the efficacy and safety of nebulized dexmedetomidine as a premedication for attenuating the hemodynamic response to laryngoscopy and intubation. The study explores its effects on various physiological parameters, including heart rate, blood pressure, and catecholamine levels.

Aim and Objectives
To evaluate the effects of preoperative dexmedetomidine nebulization in blunting the stress response to laryngoscopy and intubation, to determine hemodynamic changes, dose sparing effect of propofol

2. Materials and Methods

Place of Study: Fakhruddin Ali Ahmed Medical College, and Hospital, Barpeta, Assam**.**

Study Period: One Year.

Type of Study: An Observational Comparative study.

Ethical Clearance
This research was undertaken subsequent to obtaining formal approval from the Institutional Ethics Committee at Fakhruddin Ali Ahmed Medical College, Barpeta.

Sample Size
A total of 60 patients of either sex.

Allocation of groups: The 60 patients of either sex were allocated into two study groups - Group A and Group B (30 in each group).

Group A: Included patients who received nebulisation with 5ml of normal saline, 10min before induction in sitting position.

Group B: Included patients who received 1mcg/kg dexmedetomidine diluted to 5ml, 10min before induction in sitting position.

Inclusion Criteria
The following criteria were adopted for selection of cases:
American Society of Anaesthesiologists (ASA) Grade I and II physical status and Mallampati score I and II. And

Patients aged 20 - 65 years of age irrespective of gender and BMI 20 - 29.9kg/m^2.

Exclusion Criteria:
Patient refusal for study participation, ASA III, IV, or V Hypotension and Bradycardia Patients with Cardio - vascular System (CVS), renal or hepatic dysfunction, epileptic disorders, and morbid obesity. Mallampati score III, IV

Intra - Operative Prepration: The patients allocated in the Group A received nebulization with 5ml of normal saline, while Group B was administered 1mcg/kg dexmedetomidine diluted to 5ml. Both groups received their respective nebulization 10 minutes prior to induction, with Hemodynamic parameters were systematically recorded at predetermined intervals, including: (1) the basal period (prior to administration of nebulized dexmedetomidine), (2) immediately following nebulisation, and (3) at 1, 3, 5, 10, and 20 minutes post - intubation, or until the conclusion of the surgical procedure, whichever occurred first.

3. Results and Observation

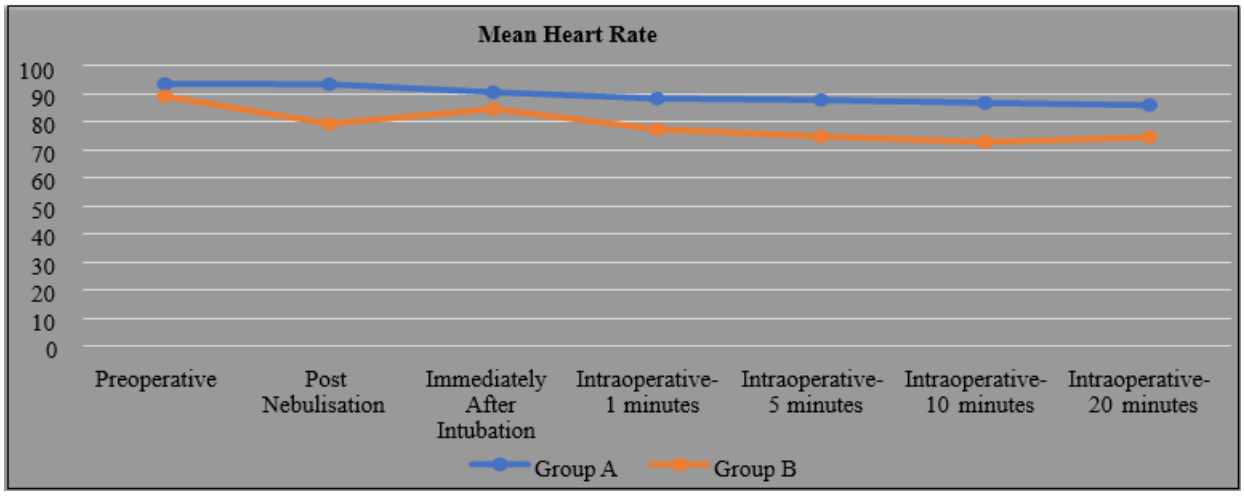
Statistical Analysis
Data collection of 60 patients were facilitated through a predesigned proforma, which was subsequently tabulated and compiled into a master chart. Statistical analysis was performed utilizing the Statistical Package for Social Sciences (SPSS) software, version 21.0, and Microsoft Excel 2010t. A p - value of <0.05 was established as the threshold for statistical significance.

The outcomes were assessed based on various parameters of hemodynamic stability including Heart Rate, Systolic and Diastolic Blood Pressure, Mean Arterial Pressure and Oxygen saturation.

Table 7: Distribution of Mean and Standard deviation of Preoperative and Intraoperative **Heart Rate** between groups

Heart Rate Distribution	Group A		Group B		t - statistic	p - value
	Mean	Standard Deviation	Mean	Standard Deviation		
Preoperative	93.63	9.79	89.23	6.09	2.091	0.042*
Post Nebulisation	93.53	8.41	79.37	5.03	7.919	<0.001*
Immediately After Intubation	90.63	9.30	84.73	7.85	2.655	0.010*
Intraoperative - 1 minutes	88.43	8.47	77.43	7.07	5.459	<0.001*
Intraoperative - 5 minutes	87.87	4.35	74.83	5.17	10.567	<0.001*
Intraoperative - 10 minutes	86.87	6.95	72.87	4.19	9.446	<0.001*
Intraoperative- 20 minutes	86.03	5.25	74.57	4.28	9.266	<0.001*

[p value <0.05 is significant]

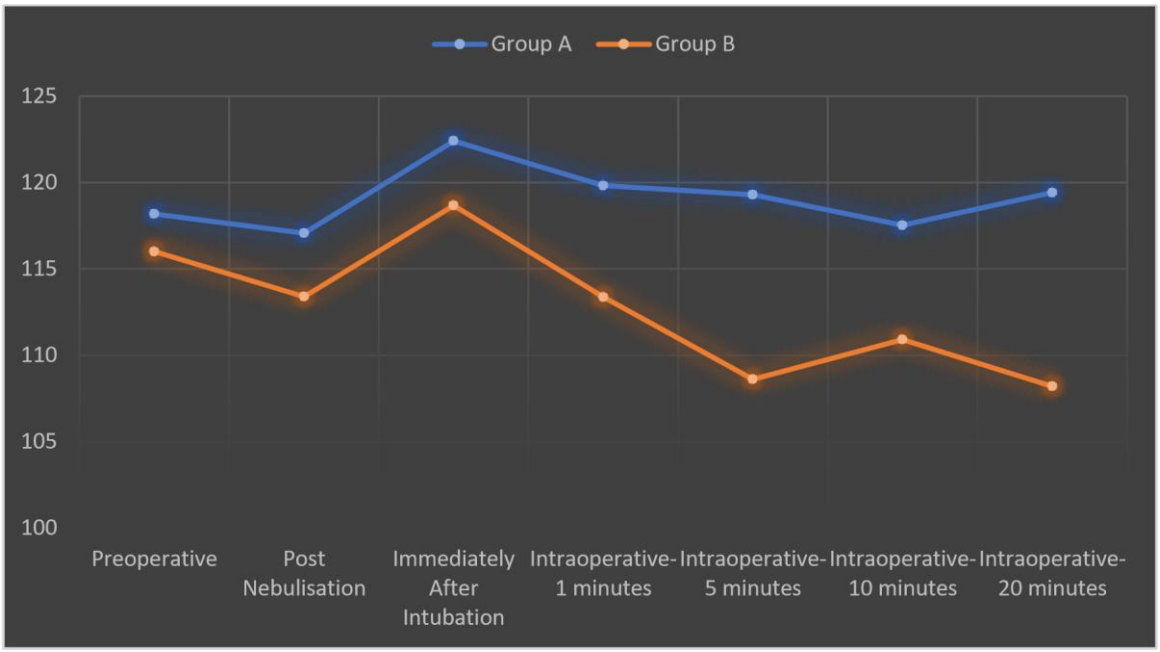


Graph 7: Graphical presentation of distribution of Mean of Preoperative and Intraoperative **Heart Rate** between groups

Table 8: Distribution of Mean and Standard deviation of Preoperative and Intraoperative Systolic blood Pressure between groups

Systolic Blood Pressure Distribution	Group A		Group B		t - statistic	p - value
	Mean	Standard Deviation	Mean	Standard Deviation		
Preoperative	118.17	8.99	116.00	7.72	1.001	0.321
Post Nebulisation	117.07	10.44	113.40	8.93	1.664	0.078
Immediately After Intubation	122.40	9.91	118.67	9.31	1.504	0.138
Intraoperative - 1 minutes	119.83	9.64	113.37	11.76	2.329	0.024*
Intraoperative - 5 minutes	119.30	8.83	108.60	13.37	3.657	<0.001*
Intraoperative - 10 minutes	117.53	7.19	110.90	14.55	2.238	0.031*
Intraoperative - 20 minutes	119.43	8.26	108.20	8.92	5.062	<0.001*

[p value <0.05 is significant]

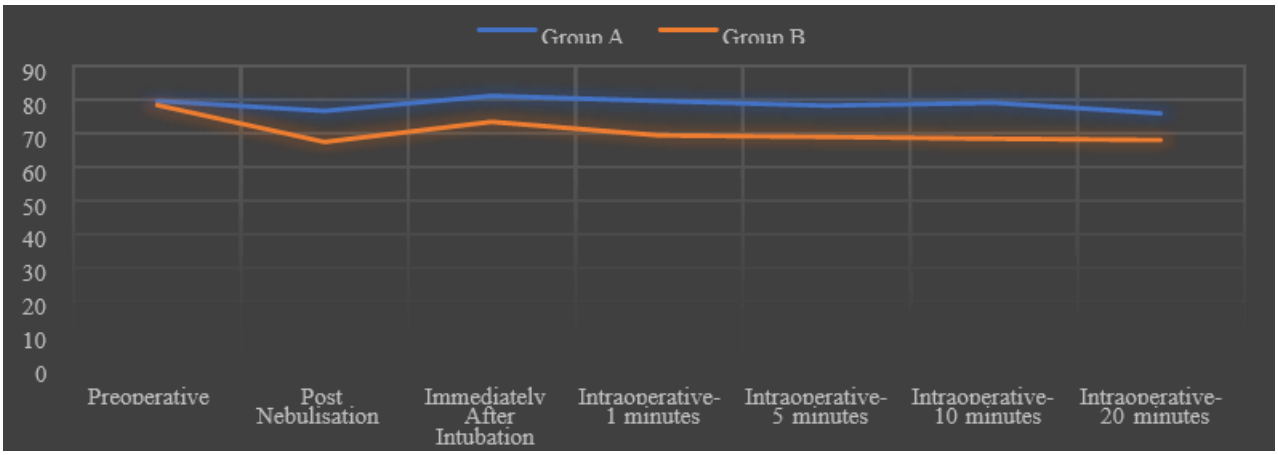


Graph 8: Graphical presentation of distribution of Mean of Preoperative and Intraoperative Systolic blood Pressure between groups

Table 9: Distribution of Mean and Standard deviation of Preoperative and Intraoperative Diastolic blood Pressure between groups

Diastolic Blood Pressure Distribution	Group A		Group B		t - statistic	p - value
	Mean	Standard Deviation	Mean	Standard Deviation		
Preoperative	79.50	2.92	78.27	3.75	1.725	0.045*
Post Nebulisation	76.50	2.92	67.27	3.65	14.095	<0.001*
Immediately After Intubation	81.03	4.13	73.30	3.15	8.150	<0.001*
Intraoperative - 1 minutes	79.50	2.92	69.27	3.75	11.798	<0.001*
Intraoperative - 5 minutes	78.10	3.71	68.78	4.71	11.251	<0.001*
Intraoperative - 10 minutes	78.98	3.71	68.27	3.58	10.875	<0.001*
Intraoperative - 20 minutes	75.80	3.31	67.84	3.23	8.254	<0.001*

[p value <0.05 is significant]



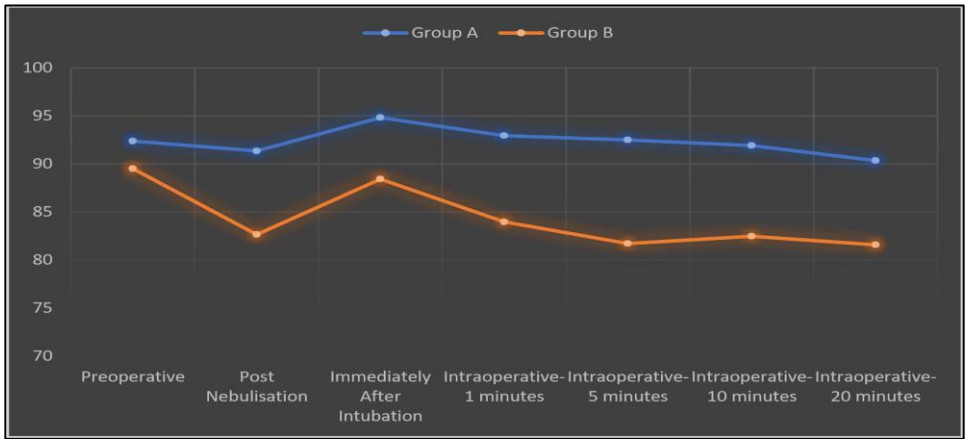
Graph 9: Graphical presentation of distribution of Mean of Preoperative and Intraoperative Diastolic blood Pressure between groups

Table 10: Distribution of Mean and Standard deviation of Preoperative and Intraoperative Mean Arterial Pressure between groups

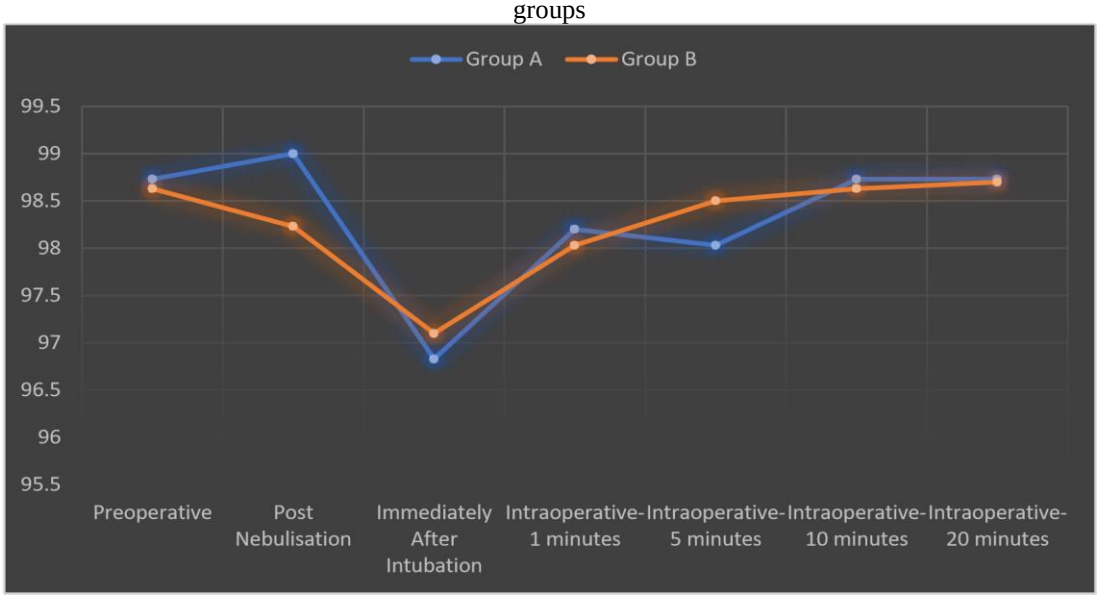
Mean Arterial Pressure Distribution	Group A		Group B		t - statistic	p - value
	Mean	Standard Deviation	Mean	Standard Deviation		
Preoperative	92.39	2.68	89.51	3.65	3.482	<0.001*
Post Nebulisation	91.35	4.09	82.64	3.31	9.061	<0.001*
Immediately After Intubation	94.82	3.65	88.42	3.69	6.743	<0.001*
Intraoperative - 1 minutes	92.94	3.68	83.96	4.83	8.092	<0.001*
Intraoperative - 5 minutes	92.50	3.81	81.71	4.75	9.692	<0.001*

Intraoperative - 10 minutes	91.91	2.93	82.48	5.12	8.757	<0.001*
Intraoperative - 20 minutes	90.34	3.37	81.58	3.72	9.561	<0.001*

[p value <0.05 is significant]



Graph 10: Graphical presentation of distribution of Mean of Preoperative and Intraoperative Mean Arterial Pressure between groups

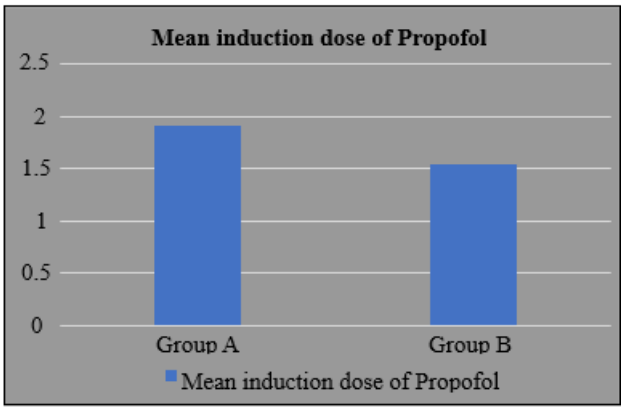


Graph - 11: Graphical presentation of distribution of Mean of Preoperative and Intraoperative SpO_2 between groups

Table 12: Mean and standard deviation of induction dose of Propofol

Study Groups	Induction dose of Propofol (mg/kg)		t - statistic	p – value
	Mean	Standard Deviation		
Group A	1.92	0.47	3.549	<0.001*
Group B	1.55	0.29		

[p value <0.05 is significant]



Graph 12: Graphical presentation of Mean induction dose of Propofol

Side effects	Study groups			
	Gro up A		Gro up B	
	N	%	N	%
Bradycardia	0	0	0	0
Hypotension	0	0	0	0
Total	30	100	30	100

4. Discussion

Laryngoscopy and intubation triggers a well - documented haemodynamic response, posing significant cardiovascular risk. This study aimed to investigate the efficacy of preoperative dexmedetomidine nebulization in attenuating this stress response. Present findings suggest that nebulized dexmedetomidine may offer a safe and effective alternative to traditional intravenous administration for managing perioperative haemodynamics. Unlike traditional sedatives, dexmedetomidine, alpha - 2 adrenergic agonists produces a calm, easily rousable state that mimics natural sleep, allowing for better patient cooperation and reduced

respiratory depression. This characteristic, combined with its analgesic and sympatholytic properties, makes dexmedetomidine an attractive option for premedication in various surgical settings.

The study was designed to compare a dexmedetomidine group to a saline control group, allowed for a clear assessment of the drug's effects. The chosen dose of 1 mcg/kg of dexmedetomidine for nebulization represents a carefully considered balance between efficacy and safety. Intranasal administration is more convenient because it is innocuous, odourless, and requires no intravenous infusion. Intranasal administration of a substance allows it to cross the blood brain barrier and reach the central nervous system directly [5, 6] because of the increased vascularity of the nasal mucosa, medications can gain rapid access to the venous blood of the systemic circulation, thereby bypassing first – pass metabolism in the liver. Nebulised dexmedetomidine improves patient comfort, shortens recovery time, reducing coughing, hemodynamic responses and avoids irritation. It avoids transient nasal irritation, coughing and vocal cord irritation associated with intranasal administration. Compared to nebulisation, intravenous achieved deeper level of sedation action than analgesic effect with profound bradycardia and hypotension.1[2] An examination of temporal variations in vital signs during and following induction reveals valuable information on the hemodynamic consequences of intravenous (Group IV) and nebulized (Group IN) dexmedetomidine administration. Notably, our findings indicate no statistically significant differences in heart rate at baseline, 0, 5, and 10 minutes post - induction, which corroborates the results of Singh et al.9 that explored the immediate hemodynamic impact of dexmedetomidine on heart rate during induction. However, a marked decline at subsequent time points suggests a delayed hemodynamic response. It provides good surgical field condition along with added advantage of lesser hemodynamic fluctuation during transnasal transphenoidal skull base surgery [7] The nasal mucosa accounts for 65% of the bioavailability of nebulised dexmedetomidine, while the buccal mucosa accounts for 82% [8].

Demographic Distributions

The age distribution across both groups was relatively balanced, covering a wide range from 20 to over 60 years old. The gender distribution, with 70% male and 30% female participants in both groups. Physiological differences between males and females, such as variations in body composition, hormonal influences, and cardiovascular responses, might affect the hemodynamic response to both laryngoscopy and dexmedetomidine. This gender distribution is similar to that observed in the study by Kumar N. et al., 2020 (12), which reported a 65% male participation. Regarding weight, both groups showed a similar distribution across the 51 - 80 kg range, with the majority of participants (43.3% in Group A and 53.3% in Group B) falling within the 6170 kg category. This consistency in weight distribution between the groups strengthens the comparability of present results, as weight can significantly influence drug pharmacokinetics and pharmacodynamics.

Group A demonstrated an equal distribution between ASA I and ASA II, with 15 participants (50%) in each category. In contrast, Group B showed a higher proportion of ASA I participants, with 20 (66.7%) classified as ASA I and 10 (33.3%) as ASA II.

Preoperatively, both groups showed comparable baseline heart rates, with Group A slightly higher at 93.63 bpm compared to Group B at 89.23 bpm. The most striking difference emerged post - nebulization, where Group B exhibited a marked decrease to 79.37 bpm, while Group A remained relatively unchanged at 93.53 bpm.

As a highly selective α2 - adrenergic agonist, dexmedetomidine exerts its effects on the central nervous system, leading to decreased sympathetic outflow and increased parasympathetic tone. This mechanism results in several cardiovascular effects, most notably bradycardia [11, 13]. Group B maintained a significantly lower mean heart rate (84.73 bpm) compared to Group A (90.63 bpm), suggesting that dexmedetomidine effectively attenuated the sympathetic surge associated with airway manipulation.

Throughout the intraoperative period, Group B consistently maintained lower mean heart rates, with differences ranging from 11 to 14 bpm compared to Group A. This sustained effect demonstrates the prolonged action of nebulized dexmedetomidine in modulating cardiovascular responses during surgery. The statistical significance ($p < 0.05$) observed at all time points underscores the robustness of these findings. These results are consistent with previous studies, such as Neenu S. et al., 2023 [2] and Kumar N. et al., 2020 [14], which also reported significant reductions in heart rate with preoperative dexmedetomidine nebulization

From 1 minute intraoperatively onwards, statistically significant differences were observed in SBP between the two groups. Group B consistently maintained lower mean systolic blood pressures compared to Group A, with differences ranging from 6 to 11 mmHg. These findings partially align with studies like Thomas S. et al., 2023 [17,] who reported lower SBP in the dexmedetomidine group within 3 minutes of intubation. In contrast to SBP, our results showed statistically significant differences in DBP between the two groups at all time points. The most notable difference occurred post - nebulization, where Group B showed a marked decrease in DBP (67.27 mmHg) compared to Group A (76.50 mmHg).

Following intubation, although both groups experienced an increase in DBP, Group B maintained significantly lower values compared to Group A. This trend continued throughout the intraoperative period, with Group B consistently maintaining lower DBP, and differences ranging from 8 to 10 mmHg. These findings are consistent with studies by Kaila D. et al., 2023 [54] and Neema Ann Sabu et al., 2023[19,] who reported that nebulised dexmedetomidine may have a more pronounced impact on DBP compared to SBP.

Post - nebulisation, Group B showed a marked decrease in MAP (82.64 mmHg) compared to Group A (91.35 mmHg). This trend continued immediately after intubation and

throughout the intraoperative period, with Group B consistently maintaining lower MAP, and differences ranging from 9 to 11 mmHg.

These results align with findings from multiple studies, including Suryawanshi C. et al., 2022 [15] and Misra S. et al., 2021 [4,] suggesting that nebulized dexmedetomidine provides sustained control of overall blood pressure during and after intubation.

Present study observed a significant difference in the Propofol induction dose between Group A (control group) and Group B (dexmedetomidine group). Group A required a higher mean dose of 1.92 ± 0.47 mg/kg compared to Group B, which needed only 1.55 ± 0.29 mg/kg. This difference was statistically significant ($p < 0.001$), indicating that patients who received preoperative nebulized dexmedetomidine required substantially lower doses of propofol for induction of anesthesia.

The propofol - sparing effect of dexmedetomidine can be attributed to its pharmacological properties. The synergistic action of dexmedetomidine with propofol may allow for a lower dose of the latter while still achieving adequate depth of anesthesia. This reduction in propofol requirements could potentially lead to more stable hemodynamics during induction and a possible reduction in propofol - related side effects, such as hypotension. Furthermore, the analgesic properties of dexmedetomidine may contribute to a more balanced anesthesia, allowing for effective induction with lower doses of propofol [10]. No instances of clinically significant bradycardia or hypotension. This finding suggests that preoperative dexmedetomidine nebulization at the dose used in this study (1 mcg/kg) provides effective attenuation of the hemodynamic response to laryngoscopy and intubation without inducing these common side effects associated with intravenous dexmedetomidine administration."

5. Conclusion

This observational comparative study demonstrates the efficacy of preoperative dexmedetomidine nebulization in attenuating hemodynamic responses to laryngoscopy and intubation in patients undergoing elective general surgery. Compared to the control group, patients receiving dexmedetomidine nebulization exhibited significantly lower heart rates, systolic and diastolic blood pressure, and mean arterial pressure throughout the intraoperative period. Notably, oxygen saturation levels remained clinically acceptable in both groups. Additionally, dexmedetomidine nebulization resulted in a 19.3% reduction in propofol requirements for induction, highlighting its sedative effects. These findings suggest that preoperative dexmedetomidine nebulization effectively mitigates the surge in heart rate and blood pressure associated with laryngoscopy and intubation, potentially reducing the risk of adverse cardiovascular events, particularly in high - risk patients. Furthermore, this non - invasive method of administration presents a practical approach to preoperative preparation. Overall, dexmedetomidine nebulization appears to be a safe and effective technique for achieving stable hemodynamics during induction, warranting further research to explore optimal dosing regimens and long - term benefits in various surgical populations. The absence of clinically significant bradycardia or hypotension in the dexmedetomidine group underscores the therapeutic potential

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