Section: Anesthesiology

Original Research Article

EVALUATION OF PREOPERATIVE DEXMEDETOMIDINE NEBULISATION ON THE PRESSOR RESPONSE TO LARYNGOSCOPY AND INTUBATION

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ABSTRACT

Background: Direct laryngoscopy and endotracheal intubation trigger a sympathetic surge, leading to increases in heart rate and blood pressure, which can be risky in patients with cardiovascular or neurological comorbidities. Dexmedetomidine, a selective α2-adrenergic agonist, has been shown to provide sedation, analgesia, and hemodynamic stability. Nebulized administration offers a non-invasive, patient-friendly alternative.

Materials and Methods: This prospective, double-blind, randomized study included 88 adult patients (ASA I–II) undergoing elective surgery under general anesthesia. Patients were randomly allocated to receive nebulized dexmedetomidine (1 µg/kg, n=44) or saline (5 mL, n=44) 30 minutes before induction. Heart rate, blood pressure, SpO_2 , propofol requirement, sedation scores (Ramsay), and side effects were recorded from pre-nebulization to 10 minutes post-intubation.

Results: Baseline demographics were comparable. Dexmedetomidine significantly attenuated the rise in heart rate, systolic, diastolic, and mean arterial pressures during induction and intubation ($p < 0.05$). Propofol requirement was lower (84.45 ± 8.51 mg vs 101.75 ± 16.7 mg, $p < 0.001$), and Ramsay Sedation Scores were higher (3.18 ± 0.62 vs 1.93 ± 0.54, $p < 0.001$) in the dexmedetomidine group. Minor side effects, including bradycardia (6.9%) and hypotension (4.6%), were observed, with no significant differences compared to saline. Oxygen saturation remained stable.

Conclusion: Preoperative nebulized dexmedetomidine is a safe, effective, and non-invasive method to attenuate the pressor response to laryngoscopy and intubation, reduce anesthetic requirement, and enhance sedation without compromising safety.

Keywords: Dexmedetomidine, Nebulization, Laryngoscopy, Hemodynamic, General Anesthesia.

INTRODUCTION

Direct laryngoscopy (DL) is an important procedure in anesthesia that allows doctors to see the larynx and safely place a breathing tube. However, laryngoscopy and intubation can trigger a strong stress response in the body. This often leads to temporary increases in heart rate and blood pressure, as well as rises in intracranial and eye pressure, and sometimes causes coughing or bronchospasm. These changes can be risky, especially in patients with heart or brain problems.[1,2]

The main reason for this response is that stimulating the throat, larynx, and trachea activates nerves that send signals to the brain's cardiovascular center. This increases the release of stress hormones like adrenaline, causing the heart to beat faster and blood vessels to tighten. While healthy patients usually tolerate these changes, they can trigger serious problems such as heart attacks, irregular heartbeats, or dangerous blood pressure spikes in vulnerable patients.[3-5] King et al., in 1951, were among the first to document this cardiovascular pressor response, emphasizing the clinical importance of strategies to reduce such effects.[5]

Many medicines, such as beta-blockers, calcium channel blockers, opioids, and local anesthetics, have been used to reduce this response. However, they are not always fully effective and can cause side effects or act too slowly. Dexmedetomidine, a selective α2-adrenergic drug, has shown promise in controlling these reactions. It works in the brain to calm the sympathetic nervous system, leading to lower heart rate and blood pressure, while also providing sedation and reducing the need for other anesthetics.[6-7]

While dexmedetomidine is usually given intravenously, giving it as a nebulized spray is less invasive and well tolerated. The drug is absorbed quickly through the lungs and airways, giving predictable effects and keeping the patient comfortable. This makes nebulized dexmedetomidine a convenient option for reducing the stress response during laryngoscopy and intubation.[8-10]

Hence, the present study aimed to evaluate whether preoperative nebulized dexmedetomidine can reduce the pressor response to laryngoscopy and intubation, while also assessing its effects on sedation, anesthetic requirement, and perioperative blood pressure and heart rate stability.

MATERIALS AND METHODS

This study was a prospective, double-blind, randomized controlled trial conducted on adult patients undergoing elective surgery under general anesthesia with endotracheal intubation. Patients aged 18–60 years of either gender with ASA physical status I or II who gave written consent were included. Patients with predicted or difficult airway, cardiac or neurosurgical procedures, emergency surgery, pregnancy, bradycardia, hypotension, heart blocks, renal failure, seizure disorders, or known allergy to dexmedetomidine were excluded. Ethical approval was obtained from the Institutional Ethics Committee (Approval No. 782/GMC/IEC/2023/Reg.No.737/IEC/R-06-09-2023).

A total of 88 patients were enrolled and randomly divided into two groups of 44 using the chit-box method. Group A received nebulized dexmedetomidine (1 µg/kg diluted to 5 mL with 0.9% saline), and Group B received 5 mL of 0.9% saline. Nebulization was performed for 10 minutes in the sitting position, 30 minutes before anesthesia. Heart rate, blood pressure, and SpO_2 were monitored before, during, and after nebulization.

In the operating room, standard monitoring included ECG, noninvasive blood pressure (systolic, diastolic, mean), SpO_2 , and end-tidal CO_2 . Patients were preoxygenated for 3 minutes and given IV midazolam (0.05 mg/kg) and fentanyl (2 µg/kg). Anesthesia was induced with propofol (2–2.5 mg/kg titrated) and vecuronium (0.1 mg/kg). Laryngoscopy and intubation were performed by experienced anesthetists under supervision. Hemodynamic parameters were recorded before intubation, immediately after, and every 2 minutes for 10 minutes. Additional propofol (20–30 mg), ephedrine (6 mg), or atropine (0.6 mg) was used if needed.

Anesthesia was maintained with oxygen and air (50:50) with isoflurane. After surgery, neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.4 mg), and patients were monitored in the PACU for 3 hours. Sedation was assessed using the Ramsay Sedation Scale. Complications such as bradycardia, hypotension, and drowsiness were recorded. Propofol requirement and hemodynamic stability were compared between groups.

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± SD, and categorical variables as frequency and percentage. Student's t-test and Chi-square test were used, and a p-value ≤ 0.05 was considered statistically significant.

RESULTS

In this study of 88 patients, preoperative nebulized dexmedetomidine demonstrated significant efficacy in controlling the hemodynamic response to laryngoscopy and intubation. Baseline demographics—including age, sex, weight (as shown in Table 1), and type of surgery (as shown in Table 2)—were comparable between groups, ensuring unbiased comparisons. Patients receiving dexmedetomidine consistently showed lower heart rates and reduced systolic, diastolic, and mean arterial pressures from pre-induction to 10 minutes post-intubation compared to the saline group ($p < 0.05$), indicating effective attenuation of the sympathetic stress response (as shown in Figure 1,2,3,4&5). Propofol requirement during induction was significantly lower in the dexmedetomidine group (84.45 ± 8.51 mg vs 101.75 ± 16.7 mg, $p < 0.001$), reflecting its sedative and anesthetic-sparing effect (as shown in Table 3). Ramsay Sedation Scores were also higher, suggesting improved pre-induction sedation (as shown in Table 3). Minor side effects, including bradycardia (6.9%) and hypotension (4.6%), were observed but clinically insignificant ($p = 0.56$) (as shown in Table 4). Oxygen saturation

remained stable throughout. Overall, nebulized dexmedetomidine effectively stabilizes hemodynamics, reduces anesthetic requirements, and provides safe sedation.

Table 1: Demographic Characteristics of Study Participants (n=88)

Variable	Group	Mean / Frequency	Std. Deviation / %	p value
Age (years)	Dexmedetomidine	31.57	9.58	0.358
	Saline	33.36	8.61	
Sex		**Frequency (n)**	**Percentage (%)**	
	Dexmedetomidine – Female	19	43.20%	0.829
	Dexmedetomidine – Male	25	56.80%	
	Saline – Female	17	38.60%	
	Saline – Male	26	59.10%	
Weight (kg)	Dexmedetomidine	60.02	8.93	0.594
	Saline	59.07	7.75	

Chi-square & Independent t-test applied

Table 2: Type of Surgery in study participants (n=88)

Surgical procedure	Dexmed	SALINE	exmed (%)	ALINE (%)	Total
Appendicectomy	8	8	18.20%	18.20%	16
Cholecystectomy	7	6	15.90%	13.60%	13
Discectomy	1	2	2.30%	4.50%	3
Epigastric Hernia-Repair	0	1	0.00%	2.30%	1
Fess	0	3	0.00%	6.80%	3
Hemithyroidectomy	5	6	11.40%	13.60%	11
Incisional Hernia	1	1	2.30%	2.30%	2
Laminectomy	8	0	18.20%	0.00%	8
Mastoidectomy	6	1	13.60%	2.30%	7
Miscellanious	5	12	11.40%	27.30%	17
TAH	1	3	2.30%	6.80%	4
Tympanoplasty	2	1	4.50%	2.30%	3

Chi-square test, p value p=0.29

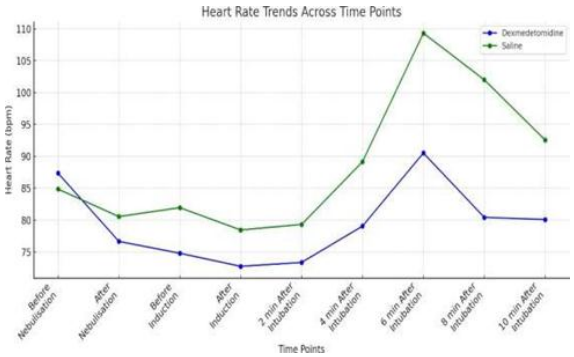

Figure 1: Mean Heart Rate in study participants (n=88)

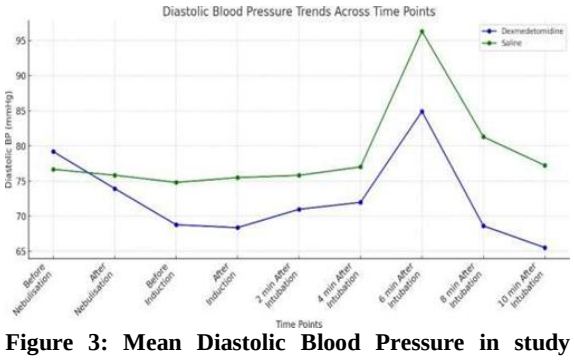

Figure 3: Mean Diastolic Blood Pressure in study participants (n=88)

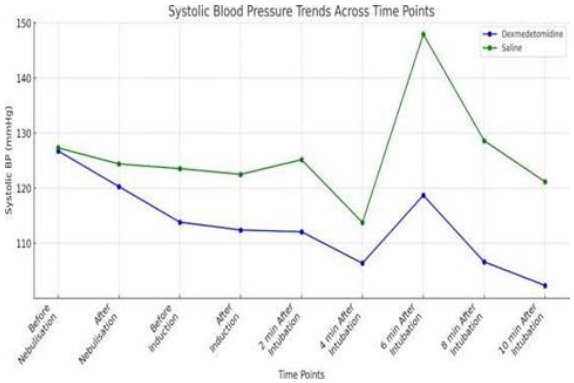

Figure 2: Mean Systolic Blood Pressure in study participants (n=88)

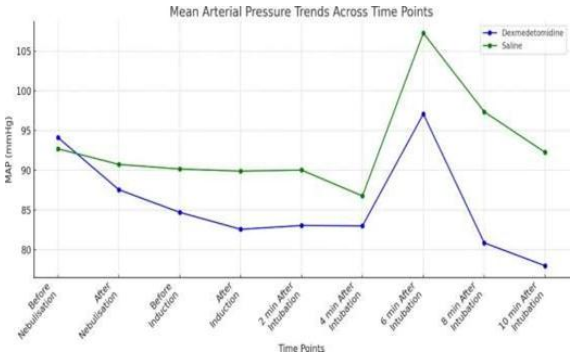

Figure 4: Mean Arterial Pressure in study participants (n=88)

Figure 5: Mean SPO2 in study participants (n=88)

Table 3: Propofol Requirement Time for Recovery and Ramsay Sedation Scores in Study Participants (n=88)

Variable	Group	Mean	Standard Deviation	p value
Propofol Requirement (mg)	Dexmedetomidine	84.45	8.51	<0.001
	Saline	101.75	16.7	
Time for Recovery (min)	Dexmedetomidine	2.87	0.12	<0.001
	Saline	2.76	0.15	
Ramsay Sedation Score	Dexmedetomidine	3.18	0.62	<0.001
	Saline	1.93	0.54	

Independent t-test applied

Table 4: Side Effects in Study Participants (n=88)

Side Effect	Group	Frequency	Percentage	p value
Bradycardia	Dexmedetomidine	3	6.9%	0.56
	Saline	1	2.3%	
Hypotension	Dexmedetomidine	2	4.6%	
	Saline	1	2.3%	
Total		7	13.8%	

Chi-square test applied

DISCUSSION

Direct laryngoscopy and intubation can cause a temporary surge in the sympathetic nervous system, leading to increases in heart rate, blood pressure, and sometimes intracranial pressure. These changes can be risky, particularly in patients with heart or brain problems. Traditional drugs such as beta-blockers, calcium channel blockers, opioids, and local anesthetics have been used to reduce this stress, but their effects are often inconsistent. Dexmedetomidine, a selective α2-adrenergic agonist with sedative and analgesic properties, has emerged as a reliable alternative. Nebulized dexmedetomidine is non-invasive, absorbed quickly, and provides predictable hemodynamic effects.

In this study, the groups were similar in age, sex, and weight, ensuring fair comparisons. The mean age was 31.57 ± 9.58 years in the Dexmedetomidine group and 33.36 ± 8.61 years in the Saline group (p = 0.358). Misra S et al,[9] conducted a randomized trial with 60 patients and reported similar ages between the dexmedetomidine and control groups (28.4 ± 7.4 vs 29.6 ± 7.6), confirming balanced demographics. Paul NS et al,[11] in a study on 50 elective surgery patients, also reported comparable mean ages, supporting reliable group allocation.

Dexmedetomidine effectively controlled heart rate. HR was lower in the Dexmedetomidine group from pre-induction to 10 minutes post-intubation (p < 0.05). Misra S et al.9 found that nebulized dexmedetomidine significantly reduced HR compared to saline during pre-induction and intubation (p = 0.012), demonstrating its sympatholytic effect. Paul NS et al,[11] reported that Group D had lower HR than controls during laryngoscopy and up to 10 minutes post-intubation (p < 0.005), confirming its protective cardiovascular role.

Blood pressure was also better controlled. Systolic, diastolic, and mean arterial pressures were consistently lower in the Dexmedetomidine group. Shrivastava P et al,[12] in a study of 100 patients receiving nebulized dexmedetomidine or saline, found significantly reduced SBP and DBP at multiple time points post-intubation (p < 0.05). Kaila D et al,[13] in 80 ASA I patients, also reported significant MAP reductions 2–8 minutes after intubation with dexmedetomidine, showing effective attenuation of the pressor response.

Secondary outcomes highlighted sedation and anesthetic-sparing effects. Dexmedetomidine reduced propofol requirement (84.45 ± 8.51 mg vs 101.75 ± 16.7 mg, p < 0.001) and increased Ramsay Sedation Scores (3.18 ± 0.62 vs 1.93 ± 0.54, p < 0.001). Misra S et al,[9] reported lower induction doses in the dexmedetomidine group (1.5 ± 0.4 mg/kg vs 1.9 ± 0.6 mg/kg, p < 0.001). Shrivastava P et al,[12] found enhanced pre-induction sedation in patients receiving nebulized dexmedetomidine, confirming its anxiolytic and sedative effects.

Safety outcomes were favorable. Bradycardia occurred in 6.9% and hypotension in 4.6% of the Dexmedetomidine group, with no significant difference from saline ($p = 0.56$). Singh V et al,[14] comparing IV and nebulized dexmedetomidine, reported low incidence of bradycardia and hypotension, and Paul NS et al,[11] also found minimal adverse events. Oxygen saturation remained stable in all patients ($p > 0.05$), confirming respiratory safety.

Overall, preoperative nebulized dexmedetomidine effectively blunts the cardiovascular stress response, reduces anesthetic requirements, enhances sedation, and maintains safety. These findings, supported by previous studies, validate its role as a practical, non-invasive premedication in elective surgery.

CONCLUSION

Preoperative nebulized dexmedetomidine is a safe, non-invasive way to blunt hemodynamic responses to laryngoscopy and intubation. Compared to saline, it significantly lowered heart rate, systolic/diastolic/mean arterial pressures peri-intubation, with better sympathetic control. It reduced propofol requirements and improved sedation (higher Ramsay Scores). Minor bradycardia, hypotension, and delayed recovery were clinically insignificant. This makes it a valuable anesthetic adjunct for enhanced stability and comfort.

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Consent: Written consent secured.

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