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To Compare the Dosage of Propofol Required at the Time of Induction with Nebulised Dexmedetomidine Vs Intranasal Dexmedetomidine

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KEYWORDS

Dexmedetomidine; Intranasal administration; Nebulization; Propofol requirement; Induction dose; General anaesthesia; Premedication.

ABSTRACT:

Background

Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, is widely used as a premedication due to its sedative, analgesic, and sympatholytic properties with minimal respiratory depression. Non-invasive routes such as intranasal and nebulized administration have gained increasing attention because of their ease of administration and favourable pharmacokinetic profiles. Premedication with dexmedetomidine has also been shown to reduce the requirement of induction agents such as propofol. However, limited data exist comparing the propofol-sparing effect of intranasal and nebulized dexmedetomidine.

Aim

To compare the dose of propofol required for induction of anaesthesia in patients premedicated with intranasal dexmedetomidine versus nebulized dexmedetomidine.

Materials and Methods

This prospective, randomized, double-blind comparative study included 60 adult patients aged 18–60 years belonging to ASA physical status I and II undergoing elective surgery under general anaesthesia. Patients were randomly allocated into two equal groups. Group IN received intranasal dexmedetomidine (1 µg/kg), while Group N received nebulized dexmedetomidine (1 µg/kg), administered 30–40 minutes before induction. Standard anaesthetic protocols were followed for all patients. Propofol was administered intravenously for induction until loss of verbal response and eyelash reflex. The total dose of propofol required for induction was recorded. Statistical analysis was performed using the unpaired t-test, and a p-value <0.05 was considered statistically significant.

Results

Patients receiving dexmedetomidine through both intranasal and nebulized routes required reduced doses of propofol for induction. The mean propofol requirement was lower in the nebulized dexmedetomidine group compared to the intranasal group, although the difference between the groups was not statistically significant ($p > 0.05$). Both routes provided adequate pre-induction sedation and facilitated smooth induction of anaesthesia.

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Conclusion

Premedication with dexmedetomidine through both intranasal and nebulized routes effectively reduces the propofol requirement for induction of anaesthesia. The propofol-sparing effect was comparable between the two routes, suggesting that both intranasal and nebulized dexmedetomidine are effective non-invasive alternatives for premedication prior to induction of general anaesthesia.

INTRODUCTION

Laryngoscopy and endotracheal intubation are essential components of general anaesthesia but are associated with significant physiological stress responses.

[1] Mechanical stimulation of the oropharynx, larynx, and trachea activates autonomic reflex pathways, leading to sympathetic stimulation characterized by tachycardia, hypertension, and increased myocardial oxygen consumption.

[2] Although these responses are generally transient in healthy individuals, they may predispose vulnerable patients to perioperative complications such as arrhythmias, myocardial ischemia, or cerebrovascular events.

[3] Consequently, anaesthetic strategies that attenuate stress responses and provide stable induction conditions are of considerable clinical importance.

[4]Propofol is widely used as an intravenous induction agent due to its rapid onset, smooth induction profile, and favourable recovery characteristics.

[5] Despite these advantages, the administration of higher doses of propofol may result in dose-dependent adverse effects such as hypotension, respiratory depression, and myocardial depression.

[6] Reducing the dose of propofol required for induction without compromising anaesthetic depth is therefore desirable in order to enhance perioperative hemodynamic stability and patient safety. The use of premedication agents capable of producing sedation and sympatholysis has been shown to decrease the requirement of intravenous induction agents.

[7]Dexmedetomidine, a highly selective α_2-adrenergic receptor agonist, has emerged as an important adjunct in modern anaesthetic practice.

[8] It produces dose-dependent sedation, analgesia, and anxiolysis by acting on central α_2 receptors in the locus coeruleus, thereby decreasing sympathetic outflow and inhibiting norepinephrine release.

[9] Unlike many sedative agents, dexmedetomidine provides these effects with minimal respiratory depression.

[10] Additionally, its sympatholytic properties help attenuate perioperative stress responses and reduce the requirement of other anaesthetic agents, including propofol and opioids.

[11]Traditionally, dexmedetomidine has been administered intravenously; however, this route may occasionally lead to adverse effects such as bradycardia and hypotension, particularly when administered rapidly or in higher doses.

[12] In recent years, non-invasive routes such as intranasal and nebulized administration have gained increasing attention. Intranasal administration allows rapid systemic absorption through the highly vascular nasal mucosa while partially bypassing first-pass hepatic metabolism. Nebulized administration delivers the drug as an aerosolized solution that is absorbed through the respiratory mucosa, providing gradual systemic uptake and a smoother pharmacodynamic profile.

[13] Both routes offer advantages such as ease of administration, improved patient comfort, and avoidance of intravenous access prior to induction.

Previous studies have demonstrated that dexmedetomidine premedication can effectively reduce the requirement of anaesthetic agents, including propofol, during induction of general anaesthesia. However, most available literature focuses on comparisons between intravenous dexmedetomidine and placebo or other sedative agents. Direct

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comparisons between intranasal and nebulized dexmedetomidine in relation to their propofol-sparing effects remain limited. Understanding whether one non-invasive route provides superior reduction in propofol requirement may help optimize premedication strategies in clinical anaesthetic practice.

Therefore, the present study was undertaken to compare the dose of propofol required for induction of anaesthesia in patients receiving intranasal dexmedetomidine versus nebulized dexmedetomidine as premedication. The findings of this study aim to contribute to evidence-based selection of non-invasive dexmedetomidine administration routes for improving induction conditions and reducing the requirement of intravenous anaesthetic agents.

AIM

To compare the propofol dose required for induction of anaesthesia in patients premedicated with intranasal versus nebulized dexmedetomidine.

OBJECTIVES

1. To Compare the total propofol requirement for induction between the intranasal and nebulized dexmedetomidine groups.
2. To Assess the Sedation Score for Premedicated Patients 30 Minutes Prior to Surgery for Every 10 Minutes using Brussels Sedation Score.

MATERIALS AND METHODS

This prospective, randomized, double-blind comparative study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants.

Sixty adult patients aged 18–60 years, belonging to American Society of Anesthesiologists (ASA) physical status I and II and scheduled for elective surgery under general anaesthesia with endotracheal intubation, were included in the study. Patients were randomly allocated into two groups of 30 each using computer-generated randomization.

Group IN received intranasal dexmedetomidine (1 µg/kg), while Group N received nebulized dexmedetomidine (1 µg/kg), administered 30 minutes before induction of anaesthesia. Sedation Score has been noted for Every 10 minutes till the Time of Induction (for 30 Minutes) using Brussels Sedation Score. Standard monitoring was applied, including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure.

Anaesthesia was induced with intravenous propofol administered slowly until loss of verbal response and eyelash reflex. The total dose of propofol required for induction was recorded. Demographic data, sedation scores, and haemodynamic parameters were documented.

The propofol dose required for induction was recorded and the mean propofol requirement was compared between the two study groups.Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and compared using the unpaired t-test. A p value <0.05 was considered statistically significant.

RESULTS AND FINDINGS:

Table 1. Demographic Characteristics of the Study Population

Variable	Intranasal Dexmedetomidine (n=30)	Nebulized Dexmedetomidine (n=30)	p value
Age (years)	37.93 ± 13.06	39.57 ± 14.93	>0.05
Height (cm)	151.23 ± 5.94	152.37 ± 7.87	>0.05
Weight (kg)	62.30 ± 9.77	65.07 ± 10.70	>0.05
ASA I	21 (70%)	16 (53.3%)	>0.05
ASA II	9 (30%)	14 (46.7%)	>0.05

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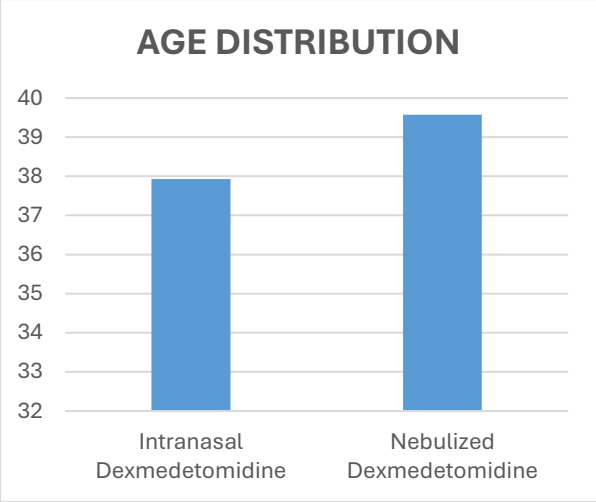

Figure 1a AGE DISTRIBUTION

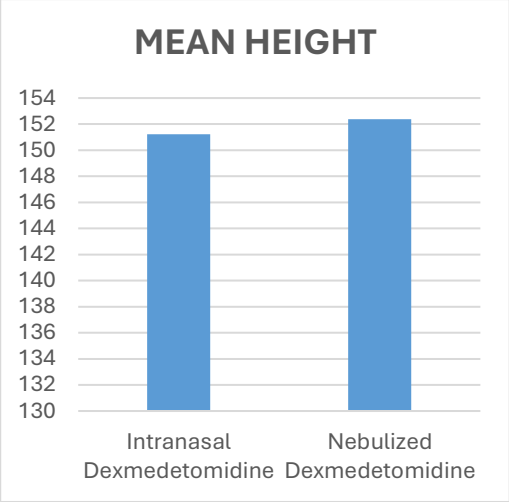

Figure 1b MEAN HEIGHT

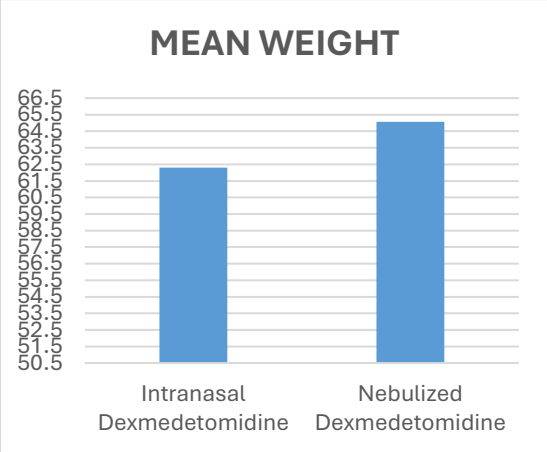

Figure 1c MEAN WEIGHT DISTRIBUTION

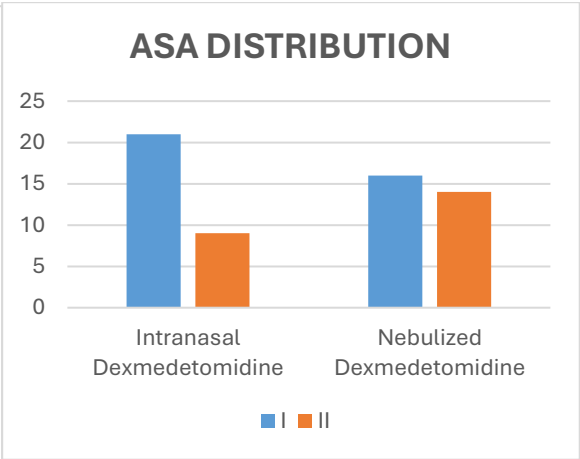

Figure 1d ASA DISTRIBUTION

Interpretation: The demographic variables including age, height, weight, and ASA status were comparable between the two groups with no statistically significant differences ($p>0.05$).

Table 2A. Comparison of Pre-Induction Sedation Score Intranasal Group

Time after Drug Administration	Sedation Score	Intranasal Group (n=30)
10 minutes	4/5	30 (100%)
20 minutes	3/5	13 (43.3%)
20 minutes	4/5	17 (56.7%)
30 minutes	3/5	24 (80%)
30 minutes	4/5	6 (20%)

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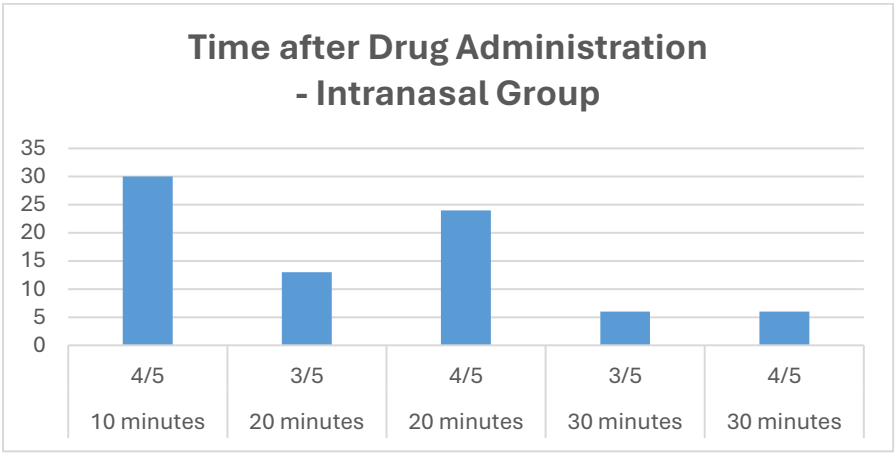

Figure 2a. Comparison of Pre-Induction Sedation Score – Intranasal Group

Table 2B. Comparison of Pre-Induction Sedation Score Nebulized Group

Time after Drug Administration	Sedation Score	Nebulized Group (n=30)
10 minutes	4/5	30 (100%)
20 minutes	3/5	18 (60%)
20 minutes	4/5	12 (40%)
30 minutes	3/5	27 (90%)
30 minutes	4/5	3 (10%)

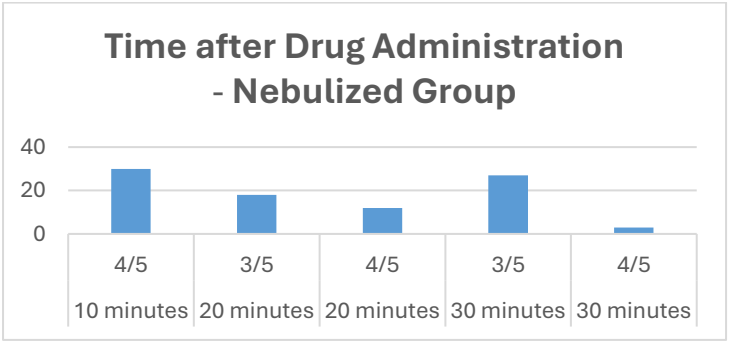

Figure 2b. Comparison of Pre-Induction Sedation Score – Nebulized Group

Interpretation: Both intranasal and nebulized dexmedetomidine produced adequate and comparable levels of pre-induction sedation without significant differences.

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Table 3. Comparison of Propofol Dose Required for Induction

Group	Number of Patients	Mean Propofol Dose (mg/kg)	Standard Deviation	p value
Intranasal Dexmedetomidine	30	1.62	0.24	>0.05
Nebulized Dexmedetomidine	30	1.54	0.21	

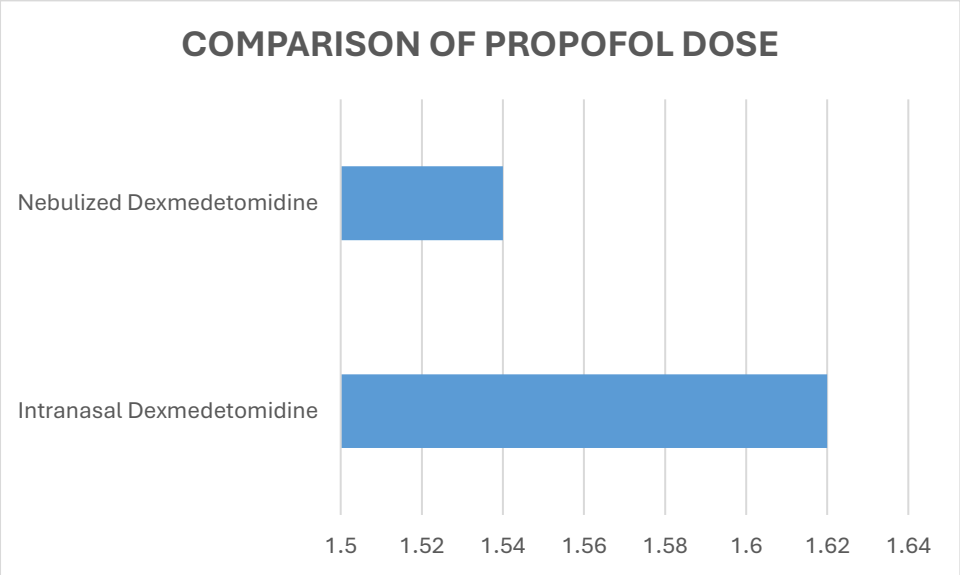

Figure 3. Comparison of Propofol Dose Required for Induction

Interpretation: Propofol dose was recorded in the master chart. Statistical analysis was performed using values from the propofol dosage column. The nebulized group required a slightly lower mean dose than the intranasal group, but the difference was not statistically significant (p>0.05). Both routes demonstrated a comparable propofol-sparing effect.

Table 4. Comparison of Heart Rate During the Study Period (beats/min)

Time Point	Intranasal Group (Mean ± SD)	Nebulized Group (Mean ± SD)	p value
Baseline	81.46 ± 3.92	80.53 ± 6.10	>0.05
1 min	83.46 ± 3.48	82.26 ± 6.31	>0.05
3 min	85.73 ± 3.92	84.60 ± 6.03	>0.05
5 min	84.53 ± 4.63	84.03 ± 6.45	>0.05
15 min	82.46 ± 4.41	82.70 ± 6.76	>0.05

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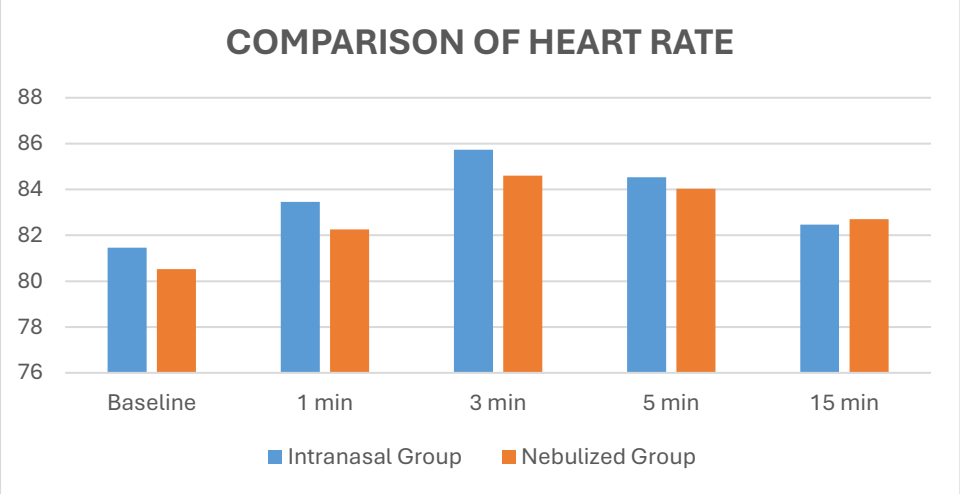

Figure 4. Comparison of Heart Rate During the Study Period

Interpretation: Heart rate remained stable in both groups throughout the peri-induction period with no clinically significant differences.

Table 5: Comparison of Systolic Blood Pressure (mmHg) Between Groups

Time Point	Intranasal Group (Mean ± SD)	Nebulized Group (Mean ± SD)	p value
Baseline	119.33 ± 8.27	120.66 ± 9.07	>0.05
1 min	124.00 ± 6.74	122.66 ± 19.46	>0.05
3 min	128.33 ± 8.74	130.33 ± 7.18	>0.05
5 min	123.86 ± 9.55	125.66 ± 22.69	>0.05
15 min	119.86 ± 9.99	124.33 ± 9.71	>0.05

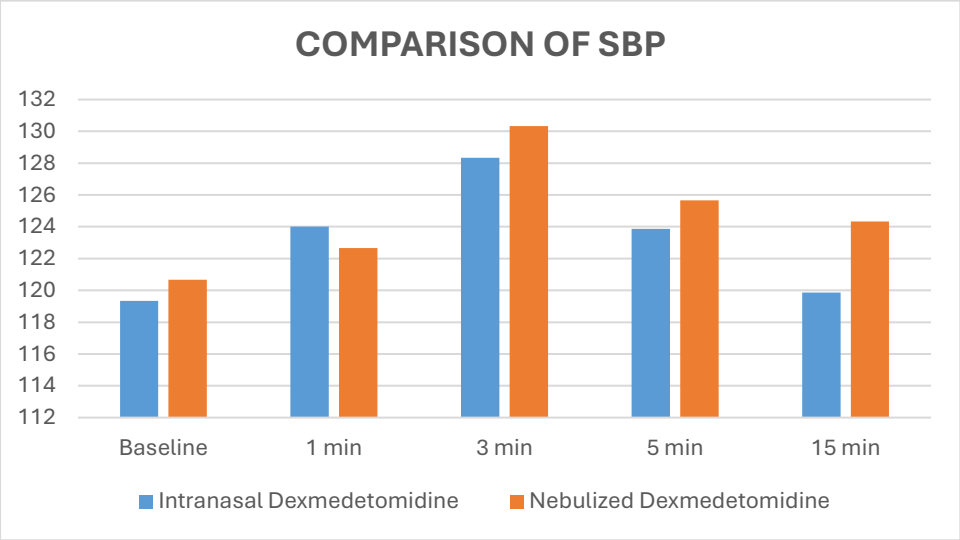

Figure 5. Comparison of Systolic Blood Pressure (mmHg) Between Groups

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Interpretation:
Systolic blood pressure exhibited transient elevation following intubation in both groups, followed by gradual normalization. Intergroup comparison demonstrated no statistically significant difference ($p > 0.05$), indicating comparable efficacy of intranasal and nebulized dexmedetomidine in attenuating systolic pressor response.

Table 6: Comparison of Diastolic Blood Pressure (mmHg) Between Groups

Time Point	Intranasal Group (Mean ± SD)	Nebulized Group (Mean ± SD)	p value
Baseline	71.26 ± 2.99	77.53 ± 4.28	>0.05
1 min	75.33 ± 4.67	79.33 ± 3.79	>0.05
3 min	79.33 ± 4.52	78.80 ± 3.13	>0.05
5 min	77.86 ± 6.34	77.06 ± 5.03	>0.05
15 min	75.60 ± 6.52	74.66 ± 6.28	>0.05

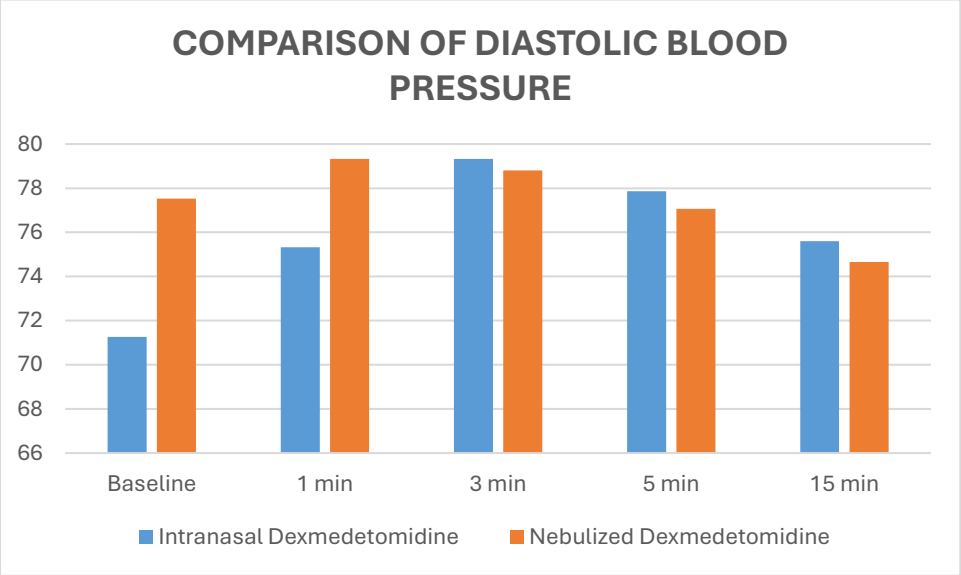

Figure 6. Comparison of Diastolic Blood Pressure (mmHg) Between Groups

Interpretation:
Diastolic blood pressure changes remained within clinically acceptable limits throughout the study period. No statistically significant intergroup differences were observed, suggesting equivalent diastolic stability with both routes of dexmedetomidine administration.

Table 7. Comparison of Mean Arterial Pressure During the Study Period (mmHg)

Time Point	Intranasal Group (Mean ± SD)	Nebulized Group (Mean ± SD)	p value
Baseline	71.26 ± 2.99	77.53 ± 4.28	>0.05
1 min	75.33 ± 4.67	79.33 ± 3.79	>0.05
3 min	79.33 ± 4.52	78.80 ± 3.13	>0.05
5 min	77.86 ± 6.34	77.06 ± 5.03	>0.05

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15 min	75.60 ± 6.52	74.66 ± 6.28	>0.05

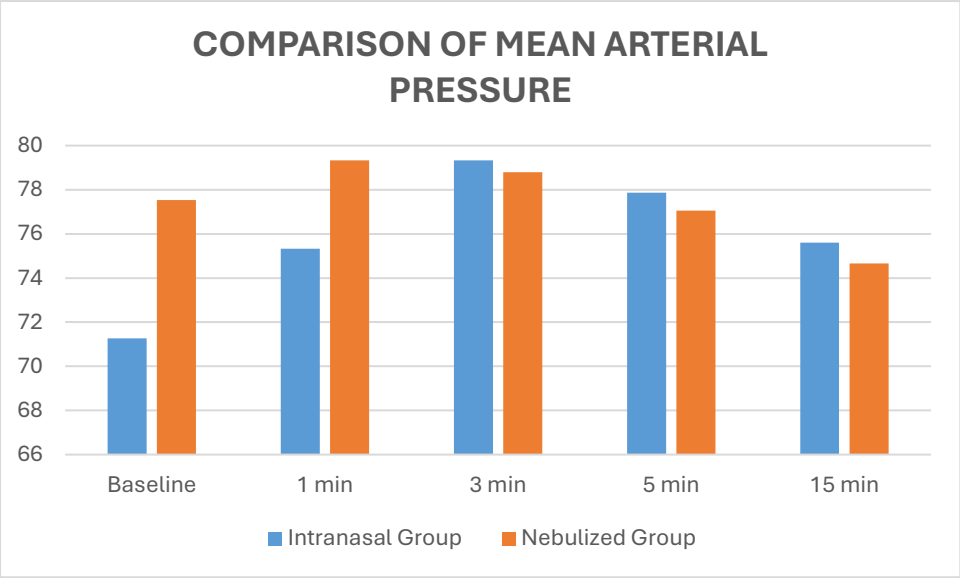

Figure 7. Comparison of Mean Arterial Pressure During the Study Period

Interpretation: Mean arterial pressure remained within clinically acceptable limits in both groups, indicating comparable haemodynamic stability.

The present study evaluated the effect of intranasal and nebulized dexmedetomidine on the propofol dose required for induction of anaesthesia. The results demonstrated that dexmedetomidine administered through both non-invasive routes produced a reduction in propofol requirement while maintaining haemodynamic stability during induction. Although the nebulized group showed a slightly lower propofol requirement than the intranasal group, the difference was not statistically significant, indicating comparable propofol-sparing effects.

Similar findings were reported by **Shrivastava et al. (2022)**[14], who investigated nebulized dexmedetomidine as a premedication before induction of anaesthesia. Their study demonstrated that nebulized dexmedetomidine significantly attenuated the haemodynamic stress response and also showed a dose-sparing effect on propofol during induction of general anaesthesia.

In another study, **Misra et al. (2020)**[15] evaluated the role of nebulized dexmedetomidine in blunting the haemodynamic response to laryngoscopy and intubation. The authors observed that preoperative nebulization with dexmedetomidine produced effective sympatholysis and improved haemodynamic stability while also reducing the requirement for anaesthetic agents during induction.

The propofol-sparing effect observed in the present study is further supported by the findings of **Walia et al. (2018)**[16], who demonstrated that pretreatment with dexmedetomidine significantly reduced the induction dose of propofol while maintaining stable haemodynamic parameters during anaesthesia.

Studies evaluating the intranasal route have also demonstrated similar anaesthetic-sparing effects. **Wu et al. (2016)**[17} reported that intranasal dexmedetomidine reduced perioperative anaesthetic requirements and provided adequate sedation without causing major haemodynamic instability. The authors concluded that intranasal administration could be an effective non-invasive alternative to intravenous premedication.

More recent investigations have also confirmed that dexmedetomidine reduces propofol requirements in a dose-dependent manner. **Xu et al. (2025)**[18] reported that dexmedetomidine significantly decreased the effective concentration of propofol required to achieve

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adequate sedation, thereby demonstrating a clear synergistic interaction between these agents.

The mechanism responsible for this propofol-sparing effect is related to the pharmacodynamic properties of dexmedetomidine. As a highly selective α_2-adrenergic receptor agonist, dexmedetomidine produces sedation and analgesia by decreasing sympathetic outflow and inhibiting norepinephrine release in the central nervous system. This results in enhanced sedation and reduced requirement for other anaesthetic agents such as propofol.

The findings of the present study are consistent with previous literature demonstrating that dexmedetomidine reduces the requirement of intravenous induction agents while maintaining haemodynamic stability. The comparable results observed between intranasal and nebulized routes suggest that both methods provide effective non-invasive alternatives for dexmedetomidine premedication prior to induction of general anaesthesia.

CONCLUSION

The present study demonstrates that premedication with dexmedetomidine administered through both intranasal and nebulized routes effectively reduces the dose of propofol required for induction of general anaesthesia. Both routes produced adequate pre-induction sedation and maintained stable haemodynamic parameters during induction. Although the nebulized dexmedetomidine group showed a slightly lower propofol requirement compared with the intranasal group, the difference was not statistically significant. These findings indicate that both intranasal and nebulized dexmedetomidine provide a comparable propofol-sparing effect. Therefore, intranasal and nebulized dexmedetomidine may be considered effective and safe non-invasive premedication techniques for reducing induction agent requirements and improving haemodynamic stability during general anaesthesia.

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